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The MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR

REFERENCE ONLY
VOLUME XIII

PART ONE
PHYSICAL RECONSTRUCTION AND
VOCATIONAL EDUCATION

By
MAJ. A. G. CRANE, S. C.

PART TWO
THE ARMY NURSE CORPS

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The Surgeon General



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LETTER OF TRANSMISSION

I have the honor to submit herewith Volume XIII of the history of the MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR. The volume submitted comprises two parts, the first being entitled "PHYSICAL RECONSTRUCTION AND VOCATIONAL EDUCATION"; the second, "THE ARMY NURSE CORPS."

MERRITTE W. IRELAND,
Major General, the Surgeon General.

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PREFACE

In the first part of this volume, which concerns physical reconstruction and vocational education, an attempt has been made to show, first, the provisions for the central organization of the division of physical reconstruction. Reconstruction was a new field of activity in so far as the Army was concerned. Since there was every necessity for having a clear conception in War Department of the situation as a whole, with the view of anticipating and avoiding duplication and conflict of effort on the part of nonmilitary governmental agencies that were or might be concerned with the question of the physical reconstruction and vocational education of our soldiers, inevitably many details were considered and much time was consumed before War Department authorization was given for the establishment of facilities by the Medical Department to initiate and carry on the work; therefore, the records pertaining to all this have been used quite fully. Following this are discussions of the activities of the specialty in the various kinds of military hospitals—that is, not only in hospitals for the care of general cases, but also in hospitals especially designated for the care of particular types of injury or disease.

In this connection it will be apparent that throughout the description of the educational service is presented more in detail than the physical reconstruction. This is because of its greater variety and complexity and because of its general interest. The application of the educational service to curative purposes is also more novel than that of the better-established scientific procedure in physiotherapy. The wider divergence of opinion regarding value and procedure in occupational activities also justifies a more detailed account and more critical analysis.

Though development battalions were instituted primarily to relieve combat divisions and other organizations of all unfit soldiers and the physical reclamation of such men, the Medical Department's interest in these battalions was great. This interest centered in the division of physical reconstruction in the Surgeon General's Office; therefore, a chapter has been devoted to this subject and to that of convalescent centers which, following the signing of the armistice, absorbed the functions of the development battalions of which there now was not the insistent need that obtained while the Army was rapidly expanding.

Morale work among the patients of our military hospitals was essential to the successful accomplishment of the reconstruction plan; therefore a section has been devoted to this subject.

Though War Department prescribed that no disabled patients in military hospitals would be separated from the service by discharge until after they had attained complete recovery, or as complete recovery as could be expected, considering the nature of their disabilities, both functional and vocational

reeducation in many instances were left incomplete by the Medical Department to be taken up by the nonmilitary governmental agencies assigned to this work. The subject would be incomplete without a brief reference to the functions of these agencies.

Grateful acknowledgment is made to Col. Frank Billings, M. C., and Lieut. Col. Lyman Greene, M. C., for helpful suggestions and corrections regarding the manuscript. Acknowledgment is also made to Maj. F. B. Granger, M. C., for material on physiotherapy; to Lieut. Col. Charles W. Richardson, M. C., for the material on defects in hearing and speech; to Lieut. Col. Harry E. Mock, M. C., for the chapter on development battalions and convalescent centers; to Miss Susan Hills, reconstruction aide, for the account of the work of reconstruction aides in the American Expeditionary Forces. Miss Mary Corufel, Miss Ruth Pope, and Miss Emily Huger prepared the monthly statistical summaries from which tables of enrollments were compiled. Capt. Charles Harlan, S. C., and Capt. Calvin P. Stone, S. C., prepared the longer studies based upon reconstruction registers and personnel records. Without this assistance and hearty cooperation it would have been impossible to present the facts in as complete, concise, and analytic form as it is believed has been done.

After the preliminary work on this portion of the volume had been completed, supplementary matter having then become available was added by Maj. A. S. Bowen, M. C., thus necessitating a rearrangement of the text. For this work of Major Bowen's acknowledgment is now made.

In the second part of this volume, having to do with the Army Nurse Corps, only the more outstanding or unusual activities of that corps, both at home and overseas, are recorded. In the preparation of the first chapter—the Army Nurse Corps in the United States—much work was done in the way of gathering material from the records and in making a preliminary arrangement of it by Miss Ruth Stevens. Various members of the Army Nurse Corps prepared accounts of activities, either of themselves or of their organizations. Since these accounts have been of material help in the preparation of the manuscript as a whole and have been freely used, the present occasion is utilized to make grateful acknowledgment to members of corps who formulated them.

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PART ONE

PART ONE

PHYSICAL RECONSTRUCTION AND VOCATIONAL EDUCATION

INTRODUCTION

When the United States entered the Great War all the countries actively participating in the conflict, on either side, had evolved more or less elaborate and apparently satisfactory systems by which to restore the wounded to such physical fitness as would warrant their return to the ranks of the fighting forces or to limited military service, or to such condition of partial physical fitness as would make necessary and possible their reeducation or vocational rehabilitation for living-making in full or in part. Along with the latter phase, in each country was evolved a system of pensions to supplement or to take the place of restoration to economic capacity.

During the Inter-Allied Conference for the Study of Professional Reeducation, held at Paris, in May, 1917,¹ representatives of France, Belgium, Russia, Portugal, Italy, and Serbia took active part in the discussion. According to the report of this conference, the greatest amount of interest was taken in the subject by the French, the Belgians, and, so far as the author of the report could judge, by all the Allies. In France, Belgium, and Italy training in hospitals was compulsory (on the advice and under the supervision of the doctor), whereas in England it was not compulsory, even in orthopedic and limbless hospitals which had workshops attached. Compulsory training ceased in France and Italy as soon as the man was discharged from the army. With the Belgians, on the other hand, the State had to maintain them, there being "no Belgium for them to go back to." For this reason training was compulsory so long as it was considered that the man required it.

On the other side of the conflict equal care has been taken to safeguard the war wounded. Sjörgen, then president of the Swedish Medical Association, reported the results of a thorough study made by him of the German plan for reeducation and return to civil life of her disabled soldiers and sailors:²

The broad and solid foundation assured by the law of May 31, 1906, had given a groundwork for the empire's responsibility and care for the thousands of wounded who have been streaming back from the various fronts in unprecedented numbers since the first weeks of the war. The well-planned and powerful organization which has been created for the purpose is called the "Kriegsbeschädigtenfürsorge," but there is no centralization of it for the whole empire. All the private forces and organizations are subordinate to the military organization, and the head of this is the medical department of each army corps, the chief corps medical officer being in charge of the whole for this section.

At Görden, in the Brandenburg district, one of the institutions visited by Sjörgen, the greatest emphasis in the aftertreatment was not placed on passive orthopedic movements, but on active gymnastic exercises carried out under military words of command.

The medical treatment and the provision of artificial limbs and functional reeducation were controlled by the imperial military authorities and were conducted along uniform lines.³

In Austria and in Hungary reeducation was obligatory and entirely controlled by the government.⁴ The military authorities provided the wounded with the first medical assistance, bore the cost of manufacturing and repairing artificial limbs as long as the patient remained in military service, met the cost of treatment in nonmilitary institutions, kept the wounded under control until recovery of earning capacity or until discharged as an invalid. The aftertreatment and vocational reeducation were controlled jointly by the military and civil authorities. Placement, on the other hand, was entirely under civilian auspices.

Thus, when we entered the war, nearly three years after its commencement, no pioneer road was left for us to follow with respect to the physical reconstruction and vocational reeducation of our wounded or otherwise disabled soldiers and sailors. It was left for us merely to select a plan and to modify it to meet our own needs.

REFERENCES

- (1) Report on the Inter-Allied Conference for the Study of Professional Reeducation, and other questions of interest to soldiers and sailors disabled by the war, held at Paris, May 8 to 12, 1917, by Lieut. Col. Sir A. Griffith Boscawen, M. P., parliamentary secretary to the Ministry of Pensions. London, His Majesty's Stationery Office, 1917.
- (2) The German plan for care, reeducation and return to civil life of disabled soldiers and sailors. Abstract of a report made to the Swedish Medical Association by its president, T. Sjörgen, and published in full in the *Fördhandlingar* of the association, November 30, 1917. *Journal of the American Medical Association*, 1918, lxx, No. 6, 379.
- (3) McMurtrie, D. C.: *The Disabled Soldier*. New York, The Macmillan Co., 1919, 210.
- (4) Op. cit., 217.

SECTION I

CENTRAL ORGANIZATION; PERSONNEL

CHAPTER I

ORGANIZATION IN THE OFFICE OF THE SURGEON GENERAL

Shortly after the United States declared war on Germany the task of organizing for the physical reconstruction of our disabled soldiers was initiated.¹ The common chairman of the committees appointed by the American Orthopedic Association and the orthopedic section of the American Medical Association in May, 1916, was commissioned in the Medical Reserve Corps, United States Army, in May, 1917, and ordered to Europe to study and report on orthopedic work in the British Army.¹ Two officers were detailed in July, 1917, to study and coordinate the various activities of this special branch of surgery.¹ The reports of these officers indicated that the problem of physical reconstruction was too broad to be confined to orthopedics alone, as it applied to all branches of medicine and surgery.

The first proposal concerning the work which was later to become the function of the reconstruction service was offered as a part of the plan for the organization and development of the orthopedic department in the Surgeon General's Office and provided for a physical-therapy department and curative workshop in each orthopedic hospital.² The shops were primarily for the therapeutic effect, but the thought then was that they might lead eventually to reeducation for trade. It was urged by the officers referred to above that cooperation be secured with various organizations for civil aid in the development of the curative workshops and the later reeducation for trade, but they emphasized the necessity of keeping the prospective patients under military medical control until they would be able to assume wage-earning positions or enter upon an arranged and definite course of occupational training. There was, meanwhile, considerable incoordinated investigation of the subject by various departments of the Surgeon General's Office, as indicated by the following memorandum:³

AUGUST 15, 1917.

Memorandum for the Surgeon General.

Subject: Reconstruction, reeducation, and aftercare of disabled soldiers.

1. At a meeting of officers, including a representation from each specialist division, the following decision was reached:

Recommended that the Surgeon General designate one officer to at once make a preliminary study of the whole question, to submit at the end of two weeks a report showing the present status of this question in the United States from the legal, sociological, labor, vocational, military (attitude of Secretary of War), technical (medical, surgical, etc.), attitude of the Medical Section, National Council of Defense, and such other phases as may be shown to be pertinent during the investigation.

2. On submission of this report it is believed that the creation of the machinery which is to do this work can be begun.

T. C. Lyster,
Lieutenant Colonel, Medical Corps.

DIVISION OF SPECIAL HOSPITALS AND PHYSICAL RECONSTRUCTION

On August 22, 1917, the division of special hospitals and physical reconstruction was formed in the Office of the Surgeon General, not only to supplement the existing divisions to the end that coordinated provision might be made for specialists' treatment and training for sick and wounded soldiers abroad, for the reception, classification, distribution, treatment, and care in the United States of invalided officers and men, and for curative treatment and education for them, but also to take measures for securing employment for them when discharged.⁴

One member of the Medical Corps was placed in charge of the division by the order creating it.⁴ Five additional officers were on duty therein on October 15, 1917.⁵ Their specific duties at that time were not stated, but the enlarged roster of January 31, 1918, shows the duties assigned to each officer and gives an idea of the scope of the early plans.⁶

In addition to the chief of division, there was a representative of the division of head surgery; a technical adviser, commercial and professional education; a surgical adviser, physical reconstruction; a technical adviser, industrial education; a technical adviser, agricultural education; an officer to abstract literature on reconstruction and reeducation; an officer concerned with educational propaganda; a representative of the division of neurology and psychiatry; three architects.⁶

The work of the division of special hospitals and physical reconstruction was conducted through four sections—special hospital sites, buildings, and grounds; special surgical and medical reconstruction plans; therapeutic use of work and other physical remedies; information and literature.⁷

The first section assisted in selecting sites for hospitals, designing buildings where needed, examining existing buildings for hospital purposes and suggesting the necessary alterations, in selecting means for the therapeutic use of work, and in developing special hospital equipment, including that required for physical therapy.⁷ The personnel consisted of medical officers and architects.

The section of special surgical and medical reconstruction had charge of the development of plans for the necessary special treatment of the blind, of the deaf, of speech-defect cases, and of other conditions requiring special plans.⁷ It assisted various professional divisions in preparing for special features of their work.⁷ This section was operated by representatives from the divisions of general surgery, head surgery, orthopedic surgery, neurology and psychiatry, internal medicine, and genitourinary surgery.⁷

The section devoted directly to the therapeutic use of work assisted in the development of plans for curative shops and laboratories.⁷ This section acted in an advisory capacity in the selection of the proper application of work in so far as the medical requirements permitted with a view to future vocation and in the investigation of the occupational possibilities for handicapped men and their use in the military service. The work of this section was performed by technical advisers in such occupations as applied to the treatment of sick and wounded.⁷

The section of information and literature had charge of the analysis of reconstruction literature, educational propaganda, and the preparation of monographs for officers.⁷

The division was occupied for several months in surveying its field of endeavor, in laying plans, in preparing literature, in selecting hospitals, and in making plans for hospital building.⁸ An intensive study was made of existing literature on reconstruction, which indicated, among other points, that 50,000 to 75,000 reconstruction cases would be received per year from each 1,000,000 men overseas. Plans were made for establishing curative workshops and vocational schools in connection with certain hospitals. Conferences were held with vocational schools and with industrial establishments with a view of providing training of a vocational nature. Studies were made of the educational work being done for disabled men in the Canadian and European armies; also, investigations were made of the possibilities of employing disabled men at various occupations. For securing teachers it was proposed to establish a training school at one of the first reconstruction hospitals to be established and there to train as teachers men from civil life, as well as a certain number of disabled soldiers.

After careful investigation and study plans were prepared for the care of the blind and for those suffering with injuries to the organs of hearing and speech.⁸ The work of the industrial surgeon was fully studied and outlined, including liaison with other departments of the Surgeon General's Office and civil agencies. The possible effect of Army reconstruction measures upon the rehabilitation of those crippled in civil industry was considered.

Much work was done in investigations along the following lines:⁸ Examination of a large number of buildings offered for lease to the Government for use as hospitals, the majority of which were unsuitable; development of plans for physiotherapy in hospitals; preparation of pamphlets and moving-picture films to aid in bringing about the proper mental readjustment of men injured in war.

In the earliest organization,⁹ as shown in Chart I, three points were emphasized in the reconstruction program: (1) That the reconstruction work was expected to fall under the jurisdiction of the orthopedic department; (2) that only such reconstruction work would be undertaken overseas as was expected to return the patient to duty; (3) that military reconstruction would lead directly and shortly to industrial rehabilitation.

The statute authorizing the Bureau of War Risk Insurance, as amended October 6, 1917,¹⁰ provided for rehabilitation for permanent disability, but failed to name any governmental department to furnish the courses; also, it authorized a special enlistment for men permanently disabled, but specific authority for such enlistment was not given by The Adjutant General until January 2, 1918.¹¹ The statute is as follows:

304. That in cases of dismemberment, of injuries to sight or hearing, and of other injuries commonly causing permanent disability, the injured person shall follow such course or courses of rehabilitation, reeducation and vocational training as the United States may provide or procure to be provided. Should such course prevent the injured person from following a substantially gainful occupation while taking same, a form of enlistment may be required which shall bring the injured person into the military or naval service.

On March 21, 1918, an officer of the Medical Reserve Corps, an eminent surgeon, was assigned as chief of the division of special hospitals and physical reconstruction.¹² The Surgeon General's instructions to him were to take immediate steps to coordinate all activities of both military and civilian interests relating to physical reconstruction.

One of the first steps taken by the division under its new chief was the formulation of a building program for the proposed reconstruction hospitals. This plan was submitted March 30, 1918, and formed the basis for all building designs and hospital distribution policies thereafter.¹³ It provided for the construction of a "departmental" type of hospital in each hospital district of the United States, in addition to the few which were already operating a reconstruction service, that type having facilities for the care of all classes of cases, for the housing of all personnel, and having grounds for the development of recreation and agriculture. The buildings for the different departments were to be of standard type, in groups about the special buildings for physiotherapy,

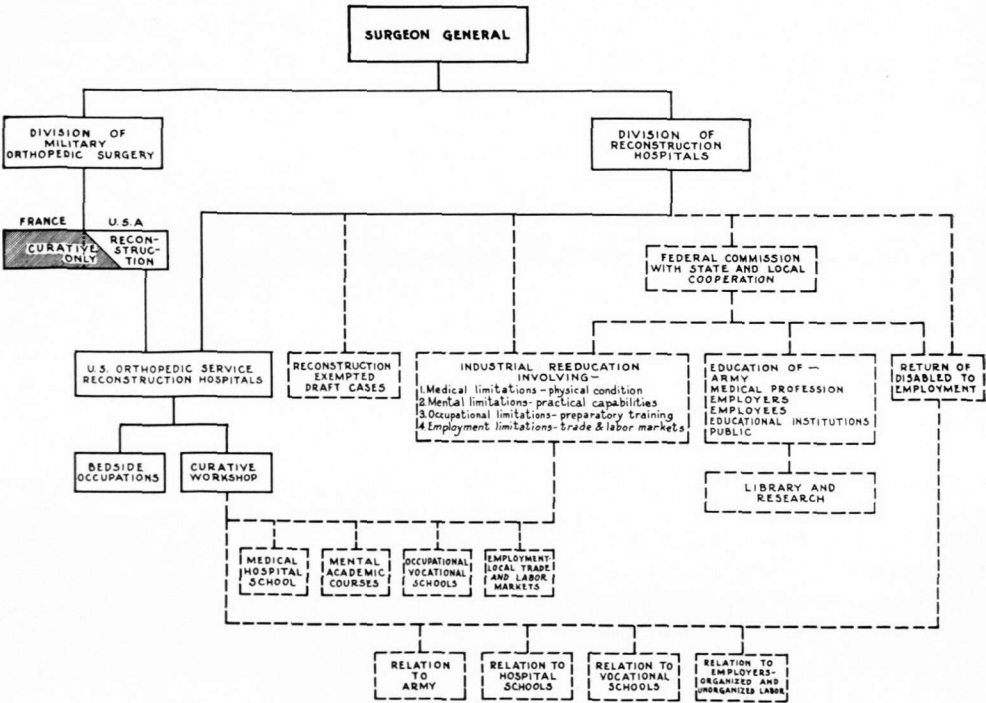


CHART I.—Early organization for physical reconstruction in the Office of the Surgeon General

curative workshops, etc., and the capacity of each hospital was to be 1,000 beds, with expansion possibilities to 2,000. The proportion of beds assigned to the various departments was to be based on the following statistics of returned invalided soldiers of the Canadian forces:

Surgical:	Beds per 1,000
General surgery	240
Orthopedic surgery	160
Head surgery	100
Medical:	
General medical (heart, genitourinary, gassing, and trench fever)	300
Nervous and mental (war neuroses and epileptics)	120
Tuberculosis	80

Provision was made for 50 per cent of the patients to receive physiotherapy, for 37½ per cent educational work, and for 37½ per cent in the curative workshops.¹³ It was considered that an area of 75 acres would be required for the first 1,000 beds and 25 acres for each additional 1,000 beds, exclusive of ground to be used for agricultural purposes. Two-story ward buildings with a capacity of 80 beds each, of terra cotta block construction, were recommended.

For the early requirements of reconstruction it was proposed to erect at once one hospital of twice the standard capacity, somewhere between the two main ports of debarkation, and at an early date one of the standard capacity in each of five districts, so located as to provide for the entire country.¹³ Wherever practicable, the use of existing buildings at posts and camps was recommended, especially for use as quarters for personnel, but the alteration of hotels for hospital use was not considered advisable from either the financial or the practical point of view. The plan also included consideration of special hospitals and additions and alterations necessary in existing hospitals functioning as reconstruction hospitals.

The plan was not adopted in detail, as a memorandum of April 29, 1918, designated certain existing hospitals to receive the various classes of reconstruction cases from overseas and from camps and stations in the United States, as follows:¹⁴

APRIL 29, 1918.

Memorandum for all officers of the Surgeon General's Office:

1. The following hospitals have been designated as points to which patients will be sent for physical reconstruction.

2. These hospitals will receive cases from abroad and from camps and stations in the United States.

3. The necessary special staff of all types will be assigned to these hospitals as rapidly as possible.

4. Arrangements have been made for the prompt classification and evacuation of cases from ports to these hospitals. Steps are under way to further improve and expedite this evacuation.

5. Arrangements have been begun for the transfer of cases from camps and stations to these hospitals. It is expected that these arrangements will be completed shortly to the end that every case needing reconstruction will be promptly transferred from camps and stations to the designated hospital.

6. List of hospitals:

For the insane (overseas patients)—

All enlisted men arriving at Newport News and New York—Fort Porter, N. Y.

Officers (these officers can be treated in a ward of No. 1 which has been established at Bloomingdale)—General Hospital No. 1, Williamsbridge, N. Y.

Epileptics and those suffering from functional neuroses—Temporarily to General Hospital No. 9, Lakewood, N. J.

Pulmonary tuberculosis cases—For the present, to Fort Bayard, N. Mex.; General Hospital No. 16, New Haven, Conn.; General Hospital No. 17, Markleton, Pa.; United States Army Hospital, Waynesville, N. C.

NOTE.—Other hospitals are in preparation at Azalea, N. C., Denver, Colo., and Otisville, N. Y.

Cardiovascular cases—General Hospitals No. 6 and No. 9.

Drug addicts—Temporarily to General Hospital No. 9, Lakewood, N. J.; to General Hospital No. 10 when completed.

Chronic arthritis—General Hospitals No. 6 and No. 9.

NOTE.—All cases which will benefit by special treatment provided at Hot Springs, Ark., will be recommended from these hospitals for transfer to that hospital.

Cases suffering from effects of gas—General Hospital No. 2.

Other general medical cases—General Hospitals Nos. 2, 5, 6, and Walter Reed General Hospital. Surgical cases:

Orthopedic—General Hospital No. 2.

Amputations (other than amputations of fingers and toes)—Walter Reed General Hospital.

Blind—General Hospital No. 7, Roland Park, Baltimore, Md.

Cases of total deafness, speech defects not purely neurotic, otitis media—General Hospital No. 11, Cape May, N. J.

Venereal disease (where treatment indicated is that of venereal disease only)—General Hospital No. 5.

Wounds, other injuries, or other surgical conditions of the genitourinary system (venereal or nonvenereal)—General Hospitals Nos. 2, 5, 6 and Walter Reed General Hospital.

Diseases or injuries of the eye and its appendages, the ear, nose, and throat; injuries and neoplasms of the skull and brain (including traumatic epilepsy), spinal cord, and peripheral nerves; diseases and injuries of the face, jaw, and neck (exclusive of the thyroid gland)—General Hospital No. 11, Cape May, N. J.

Other surgical conditions—General Hospitals Nos. 2, 5, 6 and Walter Reed General Hospital.

7. These hospitals are prepared to care for both officers and enlisted men unless otherwise indicated.

8. Under the plan of evacuation now in operation the hospital to which a patient goes is determined by his major disability.

ROBT. E. NOBLE,
Colonel, Medical Corps, N. A.

On approximately the same date a letter of general instructions was sent to each of the hospitals named with the following introductory statements:¹⁵

Physical reconstruction is the completest form of medical and surgical treatment carried to the point where maximum functional restoration, mental and physical, may be secured. To secure this result, the use of work, mental and manual, will be required during the convalescent period. This therapeutic measure, in addition to aiding in greatly shortening the convalescent period, retains or arouses mental activities preventing hospitalization, and enables the patient to be returned to service or civil life with the full realization that he can work in his handicapped state, and with habits of industry much encouraged if not firmly formed.

Hereafter no member of the military service should be recommended for discharge from your hospital until he has attained complete recovery or as complete recovery as it is to be expected he will attain when the nature of his disability is considered.

The designation "occupational therapy" for therapeutic work, mental or manual, was discarded, being thereafter included in the term "curative workshop schedule."¹⁵ Reconstruction aides teaching handicraft, and any enlisted assistants they might have, were to be placed under the control of the educational officer of the hospital, and notation was to be made on the patient's clinical record of the work he performed. It was the intention to provide additional teaching personnel of suitable enlisted men by selection from those physically not qualified for full duty, by induction of others into the service, and by the employment of civilians if necessary.

On May 6, 1918, the administration of the section of reconstruction aides for physiotherapy in the Surgeon General's Office, which had theretofore been under the direction of orthopedic surgery, was transferred to the division of special hospitals and physical reconstruction,¹⁶ and on May 13, 1918, the title of the division was changed to the division of physical reconstruction.¹⁷

A reorganization of the division became effective May 31, 1918, creating the office of adjutant and the following designated sections:¹⁸ (1) Personnel;

(2) evacuation of patients from camps and of overseas patients from ports of embarkation; (3) physiotherapy; (4) educational; (5) architects; (6) care of permanent blind; (7) care of totally deaf and those suffering from speech defects; (8) education of the public and of the military service; (9) records; (10) professional consultants.

ORIGINAL PLAN FOR PHYSICAL RECONSTRUCTION

The preliminary investigations were so far advanced on November 7, 1917, that the Surgeon General submitted to the Secretary of War the following tentative plan for physical reconstruction and vocational training:¹⁹

WAR DEPARTMENT,
OFFICE OF THE SURGEON GENERAL,
Washington, November 7, 1917.

Memorandum for the Secretary of War.

Subject: Plan for physical reconstruction and vocational training.

1. It is recommended that the following plan be adopted.
2. The point has now been reached where it is necessary to begin the construction of buildings for school purposes and to arrange for the employment of teachers. It is therefore necessary that the plan receive the approval of the highest authority to which it must go preparatory to expenditure of existing appropriations, the submission of estimates for additional appropriations, and of recommendations for legislative and other action which may be necessary.
3. Reception and distribution of invalided men. The sick and wounded invalided from abroad should, so far as is possible, be received in one hospital. This hospital is to be located, if the site can be secured, on Staten Island, about 600 yards from quarantine. It will consist of the necessary buildings and staff to rapidly classify and distribute all character of cases. To provide for the rapid distribution of cases, it is necessary that local authority be competent or made competent to take final action on recommendations of the commanding officer of the hospital. If this authority can not be lodged in the commanding officer of the hospital, it should be no farther away than the commanding officer of the port of embarkation.
4. With such necessary modifications to make a smooth working machine, the following typifies the procedure at the hospital: The patient on admission to a service had his vocational and social history taken by competent persons employed for this purpose. If the hospital disposes of as many as 240 cases per day, at least 20 of these workers will be required. (See blank form attached, Exhibit A.) The patient would next be thoroughly examined by the proper medical officer, his previous history reviewed, and his present physical condition accurately recorded. If there is definite evidence that further medical or surgical treatment is required, the ward officer will make recommendation to the chief of service to that effect, suggesting transfer to one of the hospitals in the patient's home district which shall have been designated to receive cases of the kind and indicating the character of treatment needed. The chief of service will forward all of the papers to the commanding officer with his recommendations. In this type of case the question of vocational training is not considered at the receiving hospitals, but is left to be determined at the general hospital to which the patient is transferred.
5. The duty of selecting a hospital to which patients under this category are to be transferred should be placed by the commanding officer of the hospital upon the chiefs of service. It is very important, requiring a complete knowledge of the activities of the various hospitals and an accurate record from day to day of the number of beds available at each.
6. Should it appear to the examining surgeon that any patient is not in need of further treatment of any kind, having attained the maximum benefit possible, and is in his present physical condition able to follow his previous or other useful occupation without special training (the vocational and social survey must be carefully studied in all cases), he will recommend discharge on surgeon's certificate of disability. Such cases will be referred to a

board made up of one specialist, according to the service from which the man comes, one internist, and one vocational officer. If the board agrees with the recommendation and finds that the man is physically unfit for further service, it will recommend his discharge. If, however, the board be not convinced that he has attained the maximum cure and that he is able to follow a useful occupation, it will not recommend his discharge, but will recommend transfer to a suitable general hospital in his home district. Upon these boards is placed the duty of final decision as to whether or not further improvement is to be expected from treatment and of deciding whether or not by training of any kind which is provided the man can be improved in social worth. These boards will therefore be cautioned to use extreme care in all cases and a sufficient number of them provided to enable the necessary special study of individuals.

7. Should it appear to the examining surgeon that although a patient has attained the maximum curative results possible, yet because of permanent damage sustained is certainly or probably unable to follow his previous or other useful occupation without special training, he will indicate what occupations are in his opinion possible for the patient after training.

This report with the patient will be at once referred to a vocational officer direct. The vocational officer will carefully review the case and will indicate by recommendation on the papers the occupation or occupations which he thinks the patient will be able to pursue after training and the point to which he thinks the patient should be sent to undergo training. This point will always be a general hospital in his home district, subject to exceptions indicated, even though the actual training is to be done at some other point—as, for instance, if the training is to be given at an agricultural college in Massachusetts the patient will be sent to a general hospital, preferably the one nearest his home, and from this point sent to the school. This allows the giving of a short furlough where desirable.

8. In those cases such as severe brain and spinal cord injuries where the condition is such that there is no hope of improvement by medical or surgical treatment, and who are so entirely crippled as to be quite unable to follow any occupation, as the term is usually understood, even after training, the recommendation will be for transfer to the general hospital which is especially equipped for their care which is nearest the home of the patient, except that in cases where friends or relatives are at the hospital ready to receive them and are evidently able to care for them they may be examined by a discharge board, discharged on surgeon's certificate, and placed in the care of friends. As a matter of policy it is desirable in all cases that these helpless patients be sent to hospitals near their homes.

NOTE.—It may be desirable, if a considerable number of these cases accumulate, to arrange for their discharge to a soldiers' home or special hospital for permanent care.

9. This receiving hospital will be equipped and staffed so as to classify and distribute the maximum number of patients expected during any one month.

10. In the event that patients arrive at ports other than New York, it will be necessary to have a service similar to this at the general hospital located at or near these ports. Under present plans large general hospitals will be available at practically all ports on the Atlantic seaboard.

GENERAL HOSPITALS IN WHICH PHYSICAL RECONSTRUCTION WORK AND VOCATIONAL TRAINING OF CRIPPLES WILL BE UNDERTAKEN

11. I have divided the United States into 16 districts. The basis of this division is the geographical area from which divisions of the National Army were recruited. As a result of this division we have 16 hospital districts. The attached memorandum, Exhibit B, shows these hospital areas, the States included in each, and a sufficiently accurate estimate of the number of men now in the Army from each district, including the National Army, National Guard, and Regular Army. It also shows the number of hospital beds which will be needed to serve each district, assuming an annual rate of 5 per cent of the quota from each district. This is perhaps below what is to be expected if the campaign is vigorous and casualties severe.

12. With the number of hospitals indicated established and in running order by next July it will be a relatively simple matter to anticipate such further increase as becomes

necessary. Please note that the sites indicated for these hospitals and the number of beds to be placed at each are entirely tentative. Since the memorandum was prepared it has become evident that a number of the sites are not suitable and that it will be more economical to use other sites in place of some indicated. It is not possible to give a more accurate list of sites just now. An active campaign to discover all possible existing buildings which might be used and to determine the best sites is under way. The memorandum does not show sufficiently the general distribution which it is planned to give to these hospitals. There will be an excess of beds on the east coast. This will be necessary. The excess will not be so great as to be noteworthy. It is planned in selecting these sites to use existing posts if they can be obtained for approximately 20,000 beds. About nine of the camp hospitals of the National Guard are expected to be completed and utilized if available. The remainder will be located so far as possible in existing buildings leased for the purpose, with a minimum of new construction, bearing in mind the desirability which will undoubtedly exist of continuing quite a number of these institutions for a number of years after the war to complete the physical reconstruction and training of a certain number of soldiers.

13. General hospitals will be divided into two classes—one class to receive nothing but officers and enlisted men invalided from abroad, the other class to take all other cases.

14. What is a reconstruction hospital? A reconstruction hospital must be equipped to care for and give final treatment to sick and wounded men. It must include, in addition to the usual things seen in hospitals, what have been called curative workshops. Detailed plans for these have not yet been made. It must include facilities for giving all forms of special treatment, including hydrotherapy, etc. (See Exhibit C, which outlines what I call a "physical remedy unit.")

Taking a 1,500-bed general hospital as a typical unit, the services would be divided approximately as follows:

Medical.....	300
Surgical.....	600
Orthopedic.....	400
Paralyzed.....	50
Specialties, eye, ear, etc., approximately (each).....	50

It is evident that this is only an outline. A bed will serve as well for one kind of a case as another, and if there is an undue increase in one class it will be a simple matter for the commanding officer to make the proper adjustment.

VOCATIONAL TRAINING

15. Certain types of vocational training can well be begun while the man is still at the hospital. This is especially true of those occupations which are commonly called commercial. It is therefore recommended that in connection with at least one hospital in each district there be provided a commercial school to teach 250 men, with the necessary equipment and personnel. For a general outline of the plans of this school see Exhibit D.

16. For teaching agricultural work there is in course of preparation the outline of courses which can be profitably undertaken by crippled men within a period of, say, nine months. Arrangements must be made for the introduction of these courses at the various good schools which now teach agriculture.

To inaugurate these courses will no doubt entail some additional expense at the schools selected, and it may be desirable that the Federal Government defray this. The teaching staff may have to be augmented. The method of placing the men in contact with the courses given in these schools appears to be simple. All that is required is to send an officer there, preferably a medical officer if they be available; perhaps wounded officers could be utilized. This officer will have charge of what will probably be a small company, as at any other military establishment. He would be responsible for the discipline, maintenance, and general welfare of the men, leaving to the president of the school the direction of their study.

17. The matter of training men in professional lines is partially worked out but not completed. The general principles of this will be to provide the courses at Government expense at existing schools, allowing the man to attend and leaving their oversight to the

officers detailed there for duty. If at a school having agricultural classes, they would be attached to this class; otherwise under the officer on duty there. In exceptional instances where no officer was available, the man can be left on his own responsibility, being carried on the roll of some near-by command.

18. The matter of industrial training is much more difficult and more complicated. It is perhaps the least promising of the four fields for handicapped men. It is requested that this somewhat pessimistic statement be considered as tentative only. It is expected that a complete study of this subject will be ready shortly. In this connection your attention is invited to the fact that several very experienced men have rendered this opinion; namely, that it is the most promising of the four fields for handicapped men.

19. It will be noted that to carry out this scheme will require the retention of men in the military service for a period varying from a minimum of six months to a longer period for those taking larger courses. This is not at present provided for. For the duration of the war the authority of the Secretary of War would be sufficient. For those who are to be held after the declaration of peace there would be required in most instances special legislative authority. Without being certain that the interpretation is correct, I think that one section, 304, of the soldiers' and sailors' insurance bill contemplates the reenlistment into the service of men who need training. It would seem to be a much simpler and better method for all concerned to not discharge the men at all prior to the completion of their course if they are to receive training. In my judgment the ultimate effect of the two is the same. There appear to be manifest advantages in retaining them in the service—among others, his training will undoubtedly be much more quickly completed. He is comfortably cared for, well looked after, and in general much "better off" remaining in the service than if discharged and allowed to go out for a few months or a year and then come back for his training. If he is once discharged, he goes under, at least theoretically, no control, and unless he has his home or friends is subject to many evident temptations from which he might be eventually safeguarded if retained in the service.

20. Another matter which must receive attention in the very near future is the provision of artificial appliances. A study of these is being made, and a recommendation will be submitted shortly to the general effect that all amputated or others who need artificial appliances should be furnished with them before their discharge from the service. This is believed to be possible and much more satisfactory.

21. In reference to the training of the blind, a small general hospital especially equipped for this purpose is to be established. It will be in operation before it is needed. The same applies for the deaf. At both of these it will be necessary to employ a certain number of skilled teachers. It will also be possible in these, as in probably other schools, to make great use of volunteer services.

22. Your attention is further invited to the fact that in making the plans for these hospitals we are bearing in mind, so far as it is possible under the emergency demands, the development of public opinion to the degree warranted to retain similar hospitals for the training of men handicapped by industry. Figures available, which are by no means complete, indicate that the number of men who might be improved by retraining after disease or accidents in industry is equal to the number that will be handicapped by war casualties.

23. With further reference to the question of employment for handicapped men, the general plan is to have at each hospital the properly qualified employment agent, who may be an officer or civilian. It is believed that this office could be installed with profit at a relatively early date. It will be the duty of the employment officer, under the general direction of the commanding officer, to have employment available for men who are discharged on certificate of disability. To this end he will keep a card index showing each patient's condition and potentialities. He will canvass his entire district by mail, by journeys, through relatives, and by a representative volunteer committee to be appointed for this duty in his district by the Secretary of War. He will keep himself fully informed regarding the desires and potentialities of the men, so that on discharge suitable employment will await each. If any patient intends to go out of his district to reside, he will communicate with the employment officer nearest the point to which the man is going, by wire if necessary, regarding the cases.

24. This is a tentative outline of the scheme. It is in my opinion the desirable way in which to carry out physical reconstruction and vocational retraining.

(Signed) W. C. GORGAS,
Surgeon General.

EXHIBIT A. VOCATIONAL AND SOCIAL SURVEY FORM, AND PROCEEDINGS OF DISCHARGE
AND DISTRIBUTING BOARDS

(By special vocational worker)

A. GENERAL

1. Name _____ Rank _____ Company _____ Regiment _____
 Name of hospital _____
 Address (home) _____
 Age (last birthday) _____ Birthplace (city, county, and State) _____
 If born abroad, date came to United States _____ Religion _____
 Nationality of father _____; of mother _____
 Occupation of father _____
2. Man's dependents:

Name	Date of birth	Age
Wife. _____	_____	_____
Children 1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____

Other dependents _____

Educational history

3. Elementary schooling:
 Where obtained _____ Kind of school _____ Years _____

(If more than one place or country, give time, etc., in each)

Age on leaving _____ Grade on leaving _____

Reason for leaving _____

(Needed to earn money; preferred to go to work; no higher school available, etc.)

Subsequent education:

- (a) High or Secondary School. Place _____ Name of school _____
 Course taken _____ Years _____ Grade on leaving _____
 If not, how much was completed? _____
 Reason for not completing course _____
- (b) Trade or technical school. Place _____ Name of school _____
 Course taken _____ Years _____ Was course completed? _____
 If not, how much was completed? _____
 Reason for not completing course _____
- (c) Business college Place _____ Name of college _____
 Course taken _____ Years _____ Was course completed? _____
 If not, how much was completed? _____
 Reason for not completing course _____
- (d) College or university Place _____ Name of college _____
 Course taken _____ Years _____ Was course completed? _____
 If not, how much was completed? _____
 Reason for not completing course _____
- (e) Evening classes Place _____ Name of school _____
 Course taken _____ Years _____ Was course completed? _____
 If not, how much was completed? _____
 Reason for not completing course _____

- (f) Correspondence school ----- Place ----- Name of school -----
 Course taken ----- Years ----- Was course completed? -----
 If not, how much was completed? -----
 Reason for not completing course -----
 (g) Private study (give subjects) -----
 Any other education? -----

Industrial history

4. Trade or principal occupation ----- How long followed -----
 If learned by apprenticeship, or how? ----- Average wages -----
 Other work (a) ----- How long followed? -----
 (b) ----- How long followed? -----
 (c) ----- How long followed? -----
 (d) ----- How long followed? -----
 (e) ----- How long followed? -----
 (f) ----- How long followed? -----
 (g) ----- How long followed? -----

B. SPECIAL

5. Man's preference for future occupation:
 First preference ----- Reason for it -----
 Second preference ----- Reason for it -----
 6. Personal characteristics:
 A. (a) Recreations ----- (b) Hobbies -----
 (c) Favorite reading -----
 (d) Habits, as drinking -----
 B. (a) Personal appearance -----
 (b) Manner -----
 C. Intelligence (general capacity): Grade -----
 D. Occupational stability: (a) Grade -----
 (b) If candidate is changeable, state type of change -----
 (c) Extent of change -----
 (d) Cause of change -----
 (e) If candidate is changeable, has the vocational officer reasons for thinking
 that he will become stable? ----- (f) If so, what? -----
 E. Disposition: (a) Sociability ----- (b) Has candidate
 any emotional characteristic that the vocational officer would consider
 either a business asset or a business handicap? ----- (c) If so,
 what? -----
 F. Conduct as soldier (get from record) -----
 7. Training during convalescence (subjects and results) -----
 8. Type of vocations for which ability and aptitude are evident -----
 9. Vocational officer's preference and reasons for it -----
 Remarks: -----
 10. Method and place of training recommended -----
 11. Estimated period -----
 Date ----- (Signature) -----
 Place -----

C. REPORT OF DISCHARGE AND DISTRIBUTION BOARD

12. Last medical board held at ----- on ----- 191-----
 Recommendations it made: -----

EXHIBIT B

Division area	States	Estimated quota including National Army, National Guard, and Regular Army	Hospitals to serve	Beds
76th, National Army.	New England and northern New York.	84,000, including National Army, National Guard, and Regular Army.	Boston, Mass., in connection with Robert Brigham.	288
77th	New York and a small part of New York State.	89,000	Plattsburg Barracks, N. Y. General Hospital No. —, site to be selected. General Hospital No. —, site to be selected. Fort Niagara, N. Y. Fort Ontario, N. Y. Otisville, N. Y. A special hospital for tuberculosis which would serve 4 or 5 division areas (this not available); 2 general hospitals in neighborhood of Rochester. Billings estate. General Hospital No. 1, Columbia War Hospital, to be increased to. General Hospital No. —, near New York City, receiving and distributing point.	1,500 1,500 1,500 500 1,000 500 1,500
78th	New Jersey, Delaware, New York, Virginia, Maryland, and District of Columbia.	81,000	Iselin, N. J. A special orthopedic hospital, Fort McHenry, Md. Soldiers' Home, Washington. Walter Reed General Hospital to be increased by.	500 1,000 1,000 1,000
79th	District of Columbia, Maryland, and southern Pennsylvania.	National Army, National Guard, and Regular Army.	General hospital near Newport News, Va. General hospital near Philadelphia. General hospital near Pittsburgh.	2,000 1,500 1,500
80th	Virginia, West Virginia, and Pennsylvania.	National Army, National Guard, and Regular Army included here—47,000.	General Hospital in Virginia and West Virginia.	1,500
81st	North Carolina, South Carolina, Porto Rico, and Florida.	National Army—86,000.	General hospital at San Juan, P. R. General hospital, Camp Green, Charlotte, N. C. (if suitable place there could be made a tuberculosis hospital). General hospital, Camp Wadsworth, S. C. General hospital, Camp Sevier, S. C. If one place is more suitable than another for general hospital, abandon one and increase capacity of others.	300 1,000 1,000 1,000 1,000
82d	Georgia, Alabama, Tennessee, and Florida.	Regular Army and National Guard from Florida—75,000.	General hospital in vicinity of Memphis, Tenn. General hospital, Fort Oglethorpe, Ga., increased to. General hospital, Fort McPherson, Ga., increased to. General hospital, Camp Hancock. General hospital, Camp Wheeler. (if suitable place make this a special hospital for neurotic cases).	1,500 1,500 1,500 1,500 500 1,000
83d	Ohio and western Pennsylvania.	77,000	General hospital, site to be selected near Cleveland, on the lake if possible. General hospital, site to be selected in southern Michigan, northern Ohio, or southwestern corner of Pennsylvania, preferable on lake.	1,500 1,500
84th	Kentucky, Indiana, western Illinois, National Guard and Regular Army from West Virginia.	81,000	General hospital, Fort Benjamin Harrison, Ind. Near Louisville, Ky. General hospital site to be selected—Indiana, Kentucky, or West Virginia.	1,500 1,500 1,500
85th	Michigan and part of Wisconsin.	Regular Army and National Guard from both States—about 96,000.	General hospital, Fort Brady, Mich. General hospital, Fort Wayne. General hospital site to be selected in most suitable place in Wisconsin. General hospital on southern Lake Michigan in Wisconsin or Michigan.	1,000 1,500 2,000 500
86th	Illinois and small part of Wisconsin.	76,000	General hospital, Fort Sheridan, Ill. General hospital site to be selected near Chicago.	2,000 2,000
87th	Arkansas, Louisiana, Mississippi, and Alabama.	78,000	General hospital, Fort Logan H. Roots. General hospital, Hot Springs, increased to. General hospital, Camp McClellan, Anniston, Ala. (if this place is suitable, make a tuberculosis hospital). General hospital, Camp Sheridan, Montgomery, Ala. General hospital, Camp Shelby, Hattiesburg, Miss.; retained as general hospital here if site is desirable.	500 1,000 500 1,500 1,000

EXHIBIT B—continued

Division area	States	Estimated quota including National Army, National Guard, and Regular Army	Hospitals to serve	Beds
88th	Nebraska, Minnesota, Iowa, and part of Illinois.	National Guard and Regular Army from South Dakota; in addition 85,000.	General hospital, Fort Des Moines..... General hospital, Fort Snelling..... General hospital, Fort Crook..... General hospital, Fort Meade, S. Dak., if suitable.	1,500 1,500 1,000 500
89th	National Army, Kansas, Missouri, South Dakota, Nebraska, Colorado, New Mexico, Arizona; National Guard from Missouri and Kansas; Regular Army from Missouri and Kansas.	About 82,000	General hospital, Fort Riley, Kans..... General hospital in vicinity of Kansas City, Mo. General hospital where facilities of St. Louis are available.	1,000 1,500 1,500
90th	Texas and Oklahoma.....	National Army and National Guard, 40th Division, Regular Army — about 86,000.	General hospital, San Antonio, Tex..... Camp Bowie, Fort Worth, Tex.; Camp MacArthur, Waco, Tex. (select the better of the two sites and unite hospitals, if desirable, or build a hospital of). Camp Logan, Houston, Tex., if suitable site..	1,500 1,000
91st			General hospital, Presidio..... General hospital, Fort D. A. Russell, Wyo... General hospital, Vancouver Barracks, Wash. Site to be selected in Oregon for special hospital. In Colorado, special hospital for neurotics. General hospital, Fort George Wright, Wash., if suitable (or 100 beds). General hospital, Colorado, site to be selected; a special hospital for tuberculosis (number of beds to be determined).	1,500 1,500 1,500 500

EXHIBIT C

STANDARD PHYSICAL THERAPY UNIT FOR BASE AND GENERAL HOSPITALS, UNITED STATES ARMY

This unit is planned to contain special apparatus for hydrotherapy, mechanotherapy, and electrotherapeutic treatment; also a gymnasium and exercise room. There are to be placed in a U-shaped building consisting of two wings 24 by 150 feet, connected at one end by a continuous section 24 by 48 feet. One glass-inclosed porch 10 by 96 feet runs the entire length of the building, connecting with corridors extending to other buildings and hospital. A porch 8 feet wide, not inclosed, extends along three sides of the building facing the court. A hot-water-supply building, 16 by 16 feet, is placed in the posterior part of the court; the hydrotherapy department placed in the right wing. Beginning at the extreme posterior, it consists of the following:

One douche room, 24 by 48 feet, with a concrete floor draining to a center grade (in this room is the following apparatus: Four electric hot-air bath cabinets placed upon a platform raised 6 inches from the floor; one special Baruch control table for the control of the water to needle, shower, Sitz bath, and Scotch douches; one needle shower, with curtain; one seat bath; four plain shower baths); shampoo table with Leonard valve control to shampoo shower, also one special shoulder bath, one special hip bath, with connections for Leonard valve control at this table; one 12 by 12 sedative pool bath, maximum depth 4 feet, inclosed by wooden screen (this is supplied with a Lawler regulator controlling mixed water to pool and a gate valve for outflow); one scales; one drinking fountain; one sink, with drain board. The next section, 24 by 24 feet, is divided into dressing room, 12 by 24 feet; toilet, 8 by 9 feet; continuous bathroom, 12 by 15 feet.

The dressing room will be equipped with benches, chairs, and hooks for clothing. The toilet has a concrete floor. It will have two washbasins, two seats, and one urinal. Continuous bathroom also has concrete floor with center grade. It will be equipped with two tubs 8 feet 6 inches long. With each is a Leonard valve control for regulating temperature.

The next section, 24 by 24 feet, is divided into two rooms, each 12 by 24 feet, for packs and special arm and leg baths. Pack room has a concrete floor which drains to center and is

equipped with seven white-enamel pack cots and pneumatic rubber mattresses, linen closet, blanket warmer, and pack sink with drain board.

The special arm and leg bathroom has concrete floor with a trough trench drain along inner wall. There are three local "eau courant" arm baths and three "eau courant" leg baths. Each bath has a Leonard valve control and a flexible pipe leading to trench drain to carry away outflow of water. These baths are constructed so that the arm or leg can be immersed and kept in a whirlpool of water at a given temperature. In this room is a drinking fountain.

Massage room, 20 by 30 feet, is made to have 10 white pine massage tables, 30 inches high. Corridor 4 feet wide connects the special bathrooms with the front of the building to avoid passage through the massage room.

In front of this massage room is a room 20 by 24 feet containing electric bakers. There will be six wall plugs for seven electric bakers—five, size No. 1, and one, size No. 2. There will also be six white pine tables to use in connection with these bakers.

In the front section and on the left of the room for electric bakers is a room, 22 by 30 feet, for electrotherapeutic treatment.

In the center of the front section of this unit is an office, 12 by 20 feet, which is connected by a corridor with right wing. A desk is placed in the center of this room. All patients entering or leaving building must be checked in or out through this room.

To the left of the office and extending across the front part of the building is a room, 24 by 40 feet, for mechanotherapy. This room contains the following apparatus:

Special apparatus for—

1. Circumduction of arm and shoulder joint;
2. Rotation of arm and shoulder joint, active and passive;
3. Lowering of arms with flexion of forearm;
4. Flexion and extension of wrist;
5. Flexion and extension of forearm;
6. Pronation and supination of forearm;
7. Circumduction of hand;
8. Flexion and extension of fingers;
9. Extension of the thigh and leg;
10. Flexion of the thigh and leg;
11. Flexion and extension of the knee;
12. Circumduction of the foot;
13. Pulley weight apparatus for various exercises.

The entire left wing, 24 by 126 feet, is devoted to a gymnasium, exercise room, and space for such future extension as may be required.

In the inner corner and just back of the room for mechanotherapy is a lavatory having two toilets, a washbasin, and a urinal.

EXHIBIT D

SUGGESTED* PLAN FOR A SCHOOL TO TRAIN CRIPPLED MEN FOR COMMERCIAL OCCUPATIONS

The plan herewith submitted is based upon the assumption that the men who attend this school have been examined by a committee which has determined that they can profitably enter upon preparation designed to fit them for employment in a commercial occupation. By commercial occupation is meant one dealing in the selling, accounting, recording, and correspondence necessary in commerce. It also includes those occupations classified by the civil service as clerical, or stenography and typewriting.

The plan is not predicated upon an assumption that a given number will wish to be trained in any specific occupation, but is planned to offer training in almost all of the more common commercial occupations and to care for 250 men regardless of the number to be trained for particular lines. It seems advisable to make provision for offering these men the choice of training for a wide variety of occupations rather than to arrange a necessarily limited number of classes upon an assumption of what that choice may be, which at best would be only a conjecture, regardless of the nature of the study upon which that assumption might be based.

It is impossible to formulate any estimate of the number of men who will desire, or who should receive, instruction for each occupation. While it is quite probable that the injuries which they receive will be similar both in number and character to those suffered by soldiers of the allied armies in Europe, at the same time any estimate of the nature of the injuries, the former education, and the vocational desires and aspirations of the men from any particular section of the country could not be depended upon as a basis for planning a school. For these reasons the plan is extremely flexible and can readily be adapted to meet the needs of almost any group in so far as commercial training is concerned.

At the close of the war there will no doubt be many generous employers who will at once offer employment to injured soldiers and who will be willing to pay a fair wage whether it is earned or not. These philanthropic motives of employers can not be accepted as a basis for the establishment of a school, nor is it fair to expect employers to subsidize these handicapped men. Any plan for educating the wounded soldier must accept as its function making him, in so far as possible, an independent, wholly self-supporting, self-respecting workman who receives his wage because he earns it and is in no sense an object of charity.

The soldiers and sailors' insurance law provides that the disabled man's pension shall not be affected by his becoming able to contribute to his own support, and there are conclusive arguments in support of this provision. The experience with the disabled soldiers of all the European armies has demonstrated that men will make no efforts nor follow any training which will operate to diminish or discontinue their pensions. Training and subsequent employment are necessary to insure the maintenance of their social integrity, and therefore must be provided.

Existing institutions are not organized or prepared with space, teachers, and courses to give these men the instruction which is required to meet their special needs. A majority of the existing commercial schools are designed primarily to instruct young people in their later teens. Such schools as do give commercial instruction for adults are almost exclusively evening schools, with the exception of colleges and universities offering commercial instruction which usually limit this work to senior college and graduate students. The subject matter of these college courses is, as a rule, theoretical and adapted to only such persons as have completed a junior college course. The men whom the herein proposed school is designed to teach will not be in a condition physically to travel distances to and from class each day and in many cases will not be physically able to do the same amount of work that able-bodied students do in classes. Other factors, such as the diversified courses needed, dissimilar abilities and mental condition of the men and their reluctance to appear at a disadvantage among other students, require that they be trained by themselves and not in classes with men and women not similarly afflicted. The only means by which the situation may be met seems to be the establishment of special schools conducted in the military hospitals.

Considerable emphasis should be given to the fact that these men have given up in most cases fairly remunerative positions to go to the defense of their country. Their positions have been taken by others who did not go with the Army. The returned soldier's claim on an opportunity to earn a livelihood is not to be considered a concession to be granted, but rather a right to be recognized. The national emergency has made it necessary for him to leave his position, and he has in the national service not only lost the ability to follow his former occupation, but has had his range of possible occupations limited. It is altogether reasonable to expect the men who have made no such great sacrifice for their country to so readjust themselves occupationally that the employment for the disabled soldier will be possible to the lines to which his injury has limited him. The solution of the problem of the man whose position is jeopardized by the readjustment lies in his taking advantage of the present opportunity to prepare himself for advancement by attending one of the schools now in existence.

The selection of training to be given can not be based upon the idea of an even distribution among all the occupations regardless of the limitations of the injured man. Each individual soldier gave up at the call or command of his country a position which presumably he was capable of filling satisfactorily. It is the duty of the country, in so far as possible, to reinstate him in a position where he can do the work in as satisfactory a manner as before.

In determining a basis for the selection of occupations, or of training preparatory to an occupation, for disabled soldiers, men with two types of disabilities must be considered—

namely, those who have been so incapacitated that they are incapable of ever becoming, by their own efforts, entirely self-supporting, and those capable of self-support when they have been properly trained. For the latter type the basis for selection of an occupation should be—

(a) The occupation must be such that the injured man can, with his limited physical equipment, perform all the duties which the work requires.

(b) The occupation must be one in which there is a constant demand for workers.

(c) It must offer the possibility of employment and a livelihood.

Men whose disabilities prevent their becoming at best more than only partially self-supporting should be trained for occupations in which (a) they can probably find employment; (b) which will occupy their time and prevent their becoming idlers; (c) which will call for the exercise of their entire physical and mental resources.

Many, if not all, of the occupations designated as commercial can be entered readily by injured men if they have had the necessary preliminary training. Because of the opportunities which these occupations afford for the attainment of a fair degree of success and the possibilities of earning a good livelihood therein, it is planned to offer thorough training in these lines to the men returned from the battle field. Unlike many of the industrial occupations in which the value of a workman depends to a large extent upon his expertness in the manipulation of materials—that is, on his muscular dexterity—success in commercial work depends to a large extent upon a man's mental equipment. The two elements which determine the value of a workman in almost any occupation are intelligence and muscular dexterity, the proportion of those two elements varying in different occupations. It is obvious that when one of these elements is diminished the other must be increased if the man is to maintain his former wage-earning capacity and a corresponding standard of living.

In a few of the commercial occupations the crippled man is under no handicap whatever. The work is such that no considerable amount of manual work is required, and the man who has lost one arm and has had the proper training can do all the work required quite as well as one who has not experienced his misfortune. Selling real estate and insurance are examples of work of this character. Some other occupations call for very little use of the lower limbs, and therefore the man who has lost one leg, or in some cases even both legs, can perform all the tasks required. Stenography, bookkeeping, and accounting are examples of this type.

In selecting men to be given training of this character and in admitting men to this school men lacking the necessary minimum of schooling will not be assigned for commercial training. It is realized that many men unfortunately situated in their youth were unable to attend school beyond the completion of the eighth grade, but have by their own efforts, through study and reading, together with their experience, enlarged their own education and mental capacity. On the other hand, many men who in their youth had the advantage of a full common-school course have, by bad habits both mental or physical, allowed their mental powers to atrophy to such an extent that all efforts to stimulate mental growth would be futile. The determining factor in admitting men to the commercial school will not, therefore, be the possession of a common-school certificate but the verdict of the vocational committee of the hospital in which the man has been cared for. Generally speaking, however, no man will be admitted to the commercial course if he has not had the equivalent of an eighth-grade education.

The school unit is planned to take care of a group of 250 men. It is assumed that the injuries which these men have suffered will be approximately the same in character as those suffered by men in the allied armies. According to the statistics published in the report of the Inter-Allied Conference held in May, 1917, of 250 men who have suffered amputations, 95 have had amputations of an upper limb and 155 of the lower limb. The number who have suffered amputation of both arms or of both legs is practically negligible, since these statistics show that only 2 among each 10,000 have suffered the amputation of both arms and only 30 of both legs.

Courses to be offered

It is impracticable to offer specialized courses with special instructors for all of the varied lines of commercial activity. The plan submitted herewith provides for thorough and complete courses in stenography and typewriting, telegraphy, salesmanship, bookkeeping, accounting, and advertising, with provision for giving specialized instruction in numerous

other lines by means of texts, courses, and lesson sheets, which may be secured for individuals desiring these specialized courses from the extension divisions of the various State universities and the correspondence schools.

Organization of school

The school is to be operated as a part of a military hospital, but with a principal or director working under the direction of the commanding officer of the hospital. No man will be allowed to enter upon preparation for a line of work without the approval of the proper medical authority. Should the proper medical authority of the hospital at any time ascertain that the school work is proving injurious to the health or recovery of the soldier, he shall at once cause the work to be discontinued.

With these limitations, the director or principal shall have full charge of the instruction. He will plan the courses, arrange the classes, supervise instruction, and secure special instruction sheets and courses from various sources for men interested in special lines of work. He shall also seek to secure the cooperation of local business establishments to the end that the students may have the benefit of practical experience in the line of work for which they are in preparation. He shall also seek to secure lecturers from among local business men, such as insurance agents, advertising managers, printers, lithographers, engravers, floor walkers, office managers, etc. In addition he shall provide evening lecturers and motion-picture illustrations of the manufacture of various products, of efficiency methods, office organization, methods of selling and advertising, etc., under the general regulations governing the school.

Plan of teaching

There are some lines of work which are fundamental in all lines of commercial employment. Among these are English and mathematics. In recording occupations a knowledge of bookkeeping and the principles of accounting are necessary. In general office work a knowledge of shorthand and typewriting and the composition of good business letters is essential. In all lines of selling the man must know and practice the principles underlying successful salesmanship.

Therefore, regular classes in English, mathematics, shorthand, typewriting, advertising, letter writing, bookkeeping, and accounting have been provided for. The instruction in these fundamentals will not only give the man a knowledge of the subject, but will also develop power of concentration and methods and habits of study which are necessary to the success of the entire plan of the school.

The above subjects may be regarded as the constants in the plan. The variables—that is, the special subjects—will be taught in the following manner: The department will provide carefully developed printed or mimeographed courses or lesson sheets, which if studied and understood will give the men the necessary training in that subject. In many cases the excellent courses prepared by the universities for giving home-study courses to their extension students and the courses of the correspondence schools will be utilized. To supplement these courses and to inspire, stimulate, and assist the student, provision will be made for a man fully informed on the subject matter of the course to meet and consult with the student at regular stipulated times. By this means, training in the following lines will be offered: Cost accounting, municipal accounting, railroad accounting, auditing, banking, insurance, real estate, business law, store management, industrial management, lunch-room management, algebra, trigonometry, surveying, bonds and investments, proof reading, window decorating, and preparation for various civil service examinations.

This plan, which has been so admirably developed by the extension departments of various universities and proven so eminently successful with thousands of students, has the following advantages:

- (1) With a limited equipment the school can offer instruction in an almost unlimited number of subjects.

- (2) The student can advance as rapidly as his ability and his application to the work will permit. The man, moreover, who does not apply himself diligently will be stimulated by his consulting instructor. The slow student can proceed at a rate which allows him to do the work thoroughly without retarding others who grasp the work more readily.

(3) The student develops initiative and self-confidence and does not rely too much on his teacher, as students in classes are oftentimes inclined to do. He gains the power of self-education and the habit of relying upon himself, which will prove valuable after he leaves the school.

(4) By using courses which have been developed carefully by the universities and revised by these institutions after considerable experience with the students, the high quality of the instruction is insured.

(5) An instructor can meet a large number of students in a short space of time, giving each the necessary special attention and assistance.

Procedure

Soon after the soldier arrives at a general hospital having a commercial school a committee composed of the superintendent of the hospital, the principal of the school, and the man himself will carefully consider his vocational and educational record and determine the particular occupation for which he shall be trained. The principal will then give the man a program of subjects he is to study and classes he will attend.

The soldier will each day attend the classes giving the fundamental subjects required by his course, and during the school hours when he is not attending classes he will be in the assembly study room, where he will be assisted and supervised in his study by an instructor. When the student takes up a special line of work for which regular classes are not held, he will prepare his lessons in writing and submit them to an instructor. When he desires assistance, he will report at a designated hour to the instructor in charge of the work.

Each student shall be assigned to a "faculty adviser" who shall be expected to carefully supervise his work, encourage, and advise him. The faculty adviser will act in the capacity of friend and counselor and be held, in a measure, responsible for the progress of the students assigned him.

The faculty adviser shall cultivate the friendship and endeavor to secure the confidence of the students assigned to him. He shall carefully note the conduct and progress of his charges and at all times be in a position to give advice or suggestions. Should difficulties arise between any man and his instructor, the faculty adviser shall endeavor to adjust the matter in a satisfactory manner. Should the adviser find that a student is incapable of continuing the course in which he is entered, the adviser should tactfully advise that the course of the student be changed.

Weekly reports of class attendance and the grade of work of each student should be filed in the office of the principal. Whenever the work of a student is unsatisfactory, notice of this should be sent to the student's adviser from the principal's office. When the student has progressed to the extent that his discharge seems advisable, the adviser shall notify the principal to this effect. The principal will, from data with which he is provided, determine the possibility of employment in the man's home community. He will communicate with prospective employers, and when a position shall have been found will take up with the proper Army authorities the matter of the man's discharge. When a position and the discharge have been secured, the man will be handed his discharge, a certificate of graduation from the school, and an offer of a position.

Qualifications of teachers

For the teaching of the manual activities required by the occupations, teachers will be provided who have themselves overcome the handicap of physical disability—that is, in so far as possible one-arm men will teach one-arm men, etc. The teachers of commercial work shall be men who have had practical commercial experience in the lines of work which they are to teach. In so far as possible they shall have also had some experience either in the handling of men as foremen or superintendents or in actual teaching of their line of work to adults.

Subjects included in various courses

(a) Stenography, shorthand, typewriting, multigraph operation, mimeograph operation, filing, English composition, letter writing, spelling, punctuation, etc. Student may also select additional work in the following subjects: Accounting, commercial correspondence, and rapid calculation.

(b) Salesmanship (principles of salesmanship); English (effective use of language, choice of words, etc.); sales letters (student to study certain special lines such as insurance, real estate, automobiles, textiles, shoes, furniture, or other merchandise sheets on these subjects prepared by insurance companies, university extension divisions, correspondence schools, and commercial establishments).

(c) Bookkeeping and accounting (bookkeeping and principles of accounting; penmanship and selling); student may elect cost accounting, railroad accounting, auditing, banking.

(d) Advertising (principles of salesmanship, practical psychology, study of printers' type, spacing, engraving, etc.); English (the student will here receive instruction in the practical layout of advertisements with drawing board, lettering pen, brushes, etc., show-card writing, sales letters, etc.).

(e) Civil-service course (this course will seek to prepare men to successfully pass the civil-service examination of city, county, State, and national civil service commissions)—shorthand and typewriting; spelling and composition; bookkeeping and principles of accounting; mathematics; letter writing; geography; history.

Whenever a group sufficiently large to warrant the organization of a special class wishes to have class instruction in any particular line of commercial work or civil service, such as preparation for postal clerks, a class will be formed and a teacher be provided. In all of these courses provision shall be made for extreme flexibility. When a man's previous training or experience makes training in certain subjects unnecessary, he shall not be required to take this work. When any man wishes to specialize in any particular branch of any line, he should be allowed to do so. In general, no more than one year's instruction is to be offered, and whenever the hospital authorities are convinced that the man is capable of earning a fair livelihood in an occupation and a position has been secured for him he shall be released from the school and permitted to enter upon employment, provided the medical authorities are convinced that his physical condition is such that he will experience no injurious effects therefrom. So long as the school remains in session, any soldier who has been released from the school who finds that his instruction is inadequate may be readmitted to receive additional instruction.

Character of instruction

In all the work offered in this school instruction should be of an extremely practical nature. Wherever possible, pupils should do work of the character for which they are being trained for the hospital organization. For example, students in stenography after they have attained some proficiency may be assigned to do the letter writing of physicians, the principal, and teachers; students in bookkeeping should keep the accounts for the institution; arrangements should be made, whenever possible, for students in salesmanship to spend a portion of each week acting as salesmen for local stores, local insurance companies, automobile concerns, etc.; students in advertising should spend some time visiting advertising departments of stores, printing shops, engraving offices, etc.

Each teacher should have a certain specified time when he will be in his room for the purpose of consulting with students who wish special help or who wish some training differing somewhat from the regulation work of the school.

Students taking special courses of university extension divisions or correspondence schools, such as insurance, real estate, or cost accounting, will have the opportunity to receive individual assistance from their teachers. In some cases it may be possible to engage the services of a business man, such as an insurance agent, who will devote one or two evenings a week to consulting with men preparing for his line of work.

Teachers

The above unit for the training of 250 men will require the services of 11 teachers as an initial number, in addition to the principal or director, as follows: One teacher of English grammar and composition, one teacher of mathematics, one teacher of bookkeeping, one teacher of accounting, one teacher of stenography, one teacher of typewriting, one teacher of advertising, one teacher of salesmanship, one teacher of geography and history and similar academic subjects, one teacher of telegraphy, and one teacher of the use of artificial limbs.

Necessary equipment and approximate cost

10 portable blackboards, at \$10-----	\$100. 00
150 kitchen tables, approximately 30 by 36 feet, at \$3 each, to accommodate two men-----	450. 00
300 chairs, at \$1.50-----	450. 00
20 typewriters (assorted makes), at \$50 (this is the special rate at which schools purchase typewriters)-----	1, 000. 00
20 typewriter tables, at \$6-----	120. 00
1 mimeograph-----	100. 00
20 drawing boards, at \$0.75-----	15. 00
20 student telegraph outfits-----	150. 00
Pens, pencils, paper, ink, etc-----	400. 00
Total-----	2, 785. 00

Should it be found desirable to train mail clerks, special mail cases such as are used in post offices should be provided.

The following machines are very desirable and would add greatly to the effectiveness of the instruction: One adding machine, one multigraph, one addressograph, and one billing machine. Arrangements can no doubt be made whereby instruction can be given in their use in banks and other establishments of the city in or near which the hospital is located.

Bookkeeping.—The form of an account; the merchandise and each cash account; accounts with persons; the journal, ledger, and trial balance; bills receivable and bills payable accounts; the expense account and the interest account; the proprietor's account; closing the ledger; the statements; the cash book, purchase book, and sales book, how to figure interest and discount and how interest and discount affect bookkeeping entries; the accounting of drafts; the use of controlling accounts; special ledgers and various labor-saving devices in bookkeeping; the principles of single entry; changing from single entry to double entry; closing double-entry books through the journal; adjustments in ledger accounts; merchandise sales and merchandise purchases accounts; the elements of business practice; continual practice in all the principles that are presented.

Commercial correspondence.—Choice of words; how sentences are constructed; problem of the paragraph; how to punctuate; mechanical form of the letter; the paper; letterhead and envelopes; use of stereotype expressions; essentials of all business letters; orders, acknowledgments, and remittances; inquiries, recommendations, and house letters; complaints and how to adjust them; letters of application; letters of inspiration; credit and collection letters; the sales letter—principles of salesmanship and their application; follow-up systems; preparation and use of the form letter—its possibilities and limitations; duties and qualifications of the correspondent—helpful aids in his work; filing systems; postal information; general requirements of foreign correspondence.

Insurance.—Origin and nature of insurance; kinds of policies; definitions; parties to the contract and form of the policy; insurance interest; representation and concealment; warranties; special requirements of policies; principles of waiver; time of forfeiture and waiver; losses covered by the policy; recovery and subrogation.

Cost accounting.—The elements of cost; the terminology of the science; cost conditions in particular industries; the cost-finding unit; labor and wage systems; distributions of department and general burden; office and selling expenses; installation of a cost-accounting system; fitting a cost system into the general accounting system of a business; stores system; the use of cost findings in the determination of business policies.

Retail-store management.—Store organization; scientific management in retailing; how to analyze a retail store; the four chief departments and their functions; lines of authority and relation of departments. Store policy—what it means; attitude toward customers; trade-marked and nationally advertised goods; the one-price system; store democracy; telephone courtesy; treatment of special classes of customers; store service. Standards of efficiency—the store itself; standards for sales people; standard condition for employees; training of employees; how to judge their efficiency. Cost of selling—what is profit; taking the inventory; determining the turnover; classification of expenses; how to figure profits.

Buying—where to buy; buying methods; when to buy; buyer's qualifications; how to get knowledge of goods; what to buy; how much to buy; how to study needs of a community; pricing the stock. Retail advertising—some general principles; store news; when to advertise; mediums; descriptions; headings; illustrations; prices; work of the advertising manager; cooperation between selling and advertising. Retail credits and collections—some of the more important general considerations. Relation of the store to its sales people and to the public; bases of compensation; profit sharing; welfare work; education of employees; treatment of the public; appendix containing list of trade papers and books on retail salesmanship.

Retail selling.—Introduction—the purposes of retailing; fundamental problems of retail selling; factors in selling. The salesman—reasons for salesman; qualities of successful salesmen; the salesman's preparation and technical knowledge. Analyzing the goods—selling qualities; how they may be discovered; methods of demonstration of goods. Psychology of selling—how to study people; how the brain and nervous system are constructed; how the brain works; how the mind gets ideas; explanation of memory and how to improve it; human instincts and their application in business; the explanation of habit. Steps in a sale—practical methods of attracting attention to goods; arousing interest and desire; when and how to close the sale; methods to be used with different classes of people; how to meet common objections; meaning and use of suggestions. Special problems in selling—personality and what it means; how to develop the right personality; how to develop tact in selling; the proper attitude toward customers. Losses and leaks in retailing—the salesman's part in reducing them; suggestions for reduction of store expense. Principles of art applied to retail stores; principles of form and color; application of those principles to the store itself; the display of goods, store decorations, store fixtures, and window trimming.

Advertising.—The nature of advertising—what it will accomplish if properly used; why the progressive store must advertise; the class of goods which are best suited to advertising. Definition of a selling point—how to find selling point of merchandise; how to use selling points effectively after they are found. Writing the advertisement—how the selling point may be most effectively expressed in language; the headlines and the subhead; various types of headlines; kind of headlines to use in different situations. The layout—how to make a layout for a one-article advertisement; type measurements; the point system; how to figure the amount of space an advertisement will occupy; body-type sizes; faces and names; the same for display type; printing terms; borders and illustrations studied from both the mechanical and artistic point of view; proof reading. The relative importance of small and large space—how to make the most of small space; the salient features of display for the many article advertisements. Planning the whole retail advertising campaign—the yearly plan; necessary reports on which to base advertising; division of the appropriation both as to time and medium; the value of newspaper and street-car cards as mediums. A discussion of other forms of advertising mediums, such as store circulars, store paper, package insert, and a number of others. The sales letter—how to write a strong selling letter; what subjects to touch upon; when to use selling letters; outline for a mail-order campaign, including the various details which must be considered in order to make a successful bid for business by mail. Window display—interior display and arrangement; show cards. Correlating all the sales efforts of the retail store—questions of policy; training of clerks; store records; word-of-mouth advertising; how to take advantage of the regular trade movements; store organizations; and similar matters of importance.

Principles of accounting.—Fundamental accounting principles—the field of accounting; scope of individual accounts; classification of accounts; use of controlling accounts. Development of special books or original entry—classification of books of account; development of journal, cashbook, sales book, and purchase book; use of multicolumnar books. Partnership accounts—accounting clauses in partnership agreement; investment and drawing accounts; division of profit and loss; methods of figuring interest on investment; admission of new partner; dissolution. Merchandise account—wrongly kept as mixed account; methods of recording inventory, purchases, and sales; the trading account; perpetual inventory. Revenue account and statement—technical and statement form of profit and loss account; sectionalization of revenue account to provide complete information. Balance sheet—what it shows; difference between balance sheet and statement of assets and liabilities; different

forms of balance sheet; arrangement of items; comparative balance sheets; consideration of balance-sheet items from standpoints of proprietor, banker, and auditor. Good will, reserve funds and accounts, and depreciation—valuation of good will; finding the earning power of a business; good will as an account; reserve funds and accounts distinguished; difference between depreciation, fluctuation, appreciation, and maintenance; depreciation factors; methods of writing off depreciation and recording it. Preparation and use of schedules and exhibits—uses of exhibits and charts for different businesses; instructions for their preparation. Introduction to corporation accounting—kinds of corporations, their powers and advantages; the stock system; value of shares; kinds of stock; stock books and other books of a corporation; summary of Wisconsin law relating to private corporations. Opening corporation books—converting partnership into corporation; increase and decrease of capital stock; new stock issues; treasury stock; surplus and dividend accounts; manipulation of reserves to decrease dividends. Basis of capitalization—consideration of invested capital earning power and assets and good will as bases for capitalization. Bonds and funds—kinds of bonds; sinking funds; accounting for discounts and premiums on stocks and bonds. Profits, dividends, and corporation tax—definitions; payment of dividends (Wisconsin law); relation between dividends and various kinds of assets; stockholders' rights with respect to dividends; corporation tax law, its violation of accounting principles; official explanation of the law; possible changes. Voucher systems—recording of expenditures; receipts; voucher receipts and checks; monthly payment of systems; voucher register; test proofs. Prevention of fraud by accounting—check of ownership; employees' responsibility; duplicate responsibility; preventing fraud in cash and merchandise accounts; safeguarding personal accounts; protection by cost finding. Designing and accounting system—relation of accounts to business conditions; basis of the system; adaptation to particular conditions; classification of accounts; books to be used.

A number of occupations which are not generally considered commercial occupations are quite similar to commercial occupations in that the demands made upon the worker are more mental or technical than physical.

The work is usually done in an office and not in a shop. For this reason training for these occupations may be given in the proposed commercial school without any considerable additional expense. These occupations differ from commercial occupations in that they require a knowledge of shop processes and practices. They therefore offer excellent opportunities for crippled soldiers whose previous experience has given them the requisite knowledge of shop practice. Among these occupations are those of tracer, architectural draftsman, mechanical draftsman, linotype operator, monotype-keyboard operator, and proof reader.

Men with previous experience in carpentry, but who have a nicety of touch—that is, a fine coordination of the muscles of the hand which will make it possible for them to be neat about the work—may learn tracing and later become second or even first-class architectural draftsmen. Their first training should be in the use of drafting instruments, to be followed by sufficient training and practice to make them expert in lettering. At the same time they should study mathematics and plane and solid geometry. This field is especially promising for men with a fair education and previous experience in carpentry work who, because of injuries to their lower limbs, have become unable to climb ladders and work on roofs and scaffolds.

Injured men with experience in machine shops can follow a similar course to prepare them for work along the line of mechanical drafting and machine designing. Their first training should likewise be the use of drafting instruments, lettering, and tracing. They should also study shop mathematics, shop drawing, sheet-metal drafting, strength of materials, elements of mechanics, machine elements, and machine designing.

Linotype and monotype operation offer excellent opportunities for injured printers. The operators of these instruments are seated at their work, which makes these occupations desirable for printers who have received injuries to the lower limbs. To be expert in the operation of either of these machines a man must have had experience in the printing trade. There is a strong prejudice in the printing trade against the teaching of these occupations to any persons except experienced printers, and it would be difficult to find employment for a

man who knew only the operation of these machines and had not a thorough knowledge of the printing trade. For these reasons it would be unwise to offer instruction of this character to any but experienced printers.

The number of proof readers employed in any community is necessarily limited, as small establishments do not have sufficient work of this character to employ a man to devote his entire time to it. In cities, however, the opportunities for employment are numerous in printing and publishing establishments and in editorial offices. This occupation requires on the part of the worker a thorough knowledge of English grammar and composition. A proof reader should have at least a superficial knowledge of type and type setting and be familiar with proof readers' marks. In addition to good eyesight, the work does not make any great physical requirement, and a man with no lower limbs and only one hand could do the work in a satisfactory manner. For this reason this occupation seems to be a very desirable one to be taught to crippled soldiers with the necessary intellectual ability.

Shop drawing.—Principles of shop drawing—explanation of views and their arrangement in third angle projection; problems in making drawings of well known shop objects; object lines; center, extension, and dimension lines; finish marks; symbols for machine operations. Screw fastenings—bolts; machine and cup screws; studs; forms of threads; multiple threads; thread conventions; tapped holes; drawings of screw fastenings and threaded machine parts. Sections—uses of full and half sections; cross hatchings for different materials; drawing of machine parts shown in section. Sketching—pencil sketching: materials used; method of procedure; pencil sketches of shop objects. Assembly and detail drawings—the construction of complete assembly drawings from detail sketches; making detail drawings from an assembly drawing. Gearing—spur, bevel, and spiral gearing; gear calculations; working drawings of gears; dimensions of gears. Special methods of projection—oblique projection; intersections; isometric drawing; cabinet projection; shading, etc. Special conventions—electrical conventions; conventions used in structural steel work, plumbing, steam fitting, etc.; patent drawings; rules for patent drawings. Advanced problems—detail and assembly drawings of complete machines; advanced sketching; intersections and developments.

Shop mathematics—topics treated.—Common fractions—explanation of fractions; reduction of fractions; addition, subtraction, multiplication, and division of fractions; cancellation; practical problems. Money and decimals—wage calculations; wage systems; decimal equivalents of common fractions; addition, subtraction, multiplication and division of decimals; the micrometer; percentage; efficiencies. Circular measure—measurements of circles; speeds of pulleys, belts, emery wheels, etc.; cutting and grinding speeds. Ratio and proportion—simple ratios; proportion; pulley and gear ratios; gear trains; screw cutting. Mensuration—areas and volumes of simple figures; weights of materials; shop rules for plates; calculation of weights of castings from patterns. Involution and evolution—squares, cubes, and higher powers; square root and cube root; practical applications; the law of right triangles; use of mathematical tables. Principles of simple machines—types of simple levers; compound levers; the wheel and axle; gearing; pulleys; the differential hoist; the inclined plane; the wedge and screw; jack screws; efficiencies. Work, power, and energy—definitions; units of work and power; horsepower of belts; rules for belting; horsepower of steam and gas engines; principles of hydraulic and pneumatic machines; nature of heat; expansion and contraction; shrink fits. Strength of materials—tensile, compressive, and shearing stresses; ultimate strength; factor of safety; working stresses; strength of metals; strength of rope; strength of chains. Formulas—the use of letters; substitution in formulas; use of the parenthesis; writing formulas; like and unlike terms; positive and negative quantities; formation of equations. Solution of formulas—addition and subtraction of terms; transformation of equations; cancellation; algebraic multiplication and division; factoring; simple equations; simultaneous equations; quadratic equations. Tables and curves—use of tables; preparation of tables; use of curves; plotting; kinds of curves; reading curves; equation of curves. Geometric constructions—lines and angles; simple line constructions; constructions of angles; circular constructions; constructions of regular polygons; properties of regular polygons; spacing circles; the ellipse; problems in laying out work. Areas of geometrical figures—the triangle, square, rectangle, parallelogram, trapezoid, rhombus, pentagon, hexagon,

octagon; areas of circles, segments, and sectors; area of ellipses; areas of irregular figures; the planimeter. Solids—volumes and surfaces of prisms; cylinders, pyramids, cones; frustums of pyramids and cones; segments of spheres; rings; flow through pipes; the prismoidal formula; volumes of irregular objects. Trigonometry in the shop—the tangent and cotangent; laying out angles; measuring angles; shop uses of the tangent; applications to gear cutting; use of trigonometric tables; calculating heights and distances; tapers and taper turning; the sine, cosine, secant, and cosecant; dimensions of various screw threads; multiple threads; spiral gears. Solution of triangles—functions of oblique angles; the relations of sides and angles in any triangle; applications to shop problems; areas of oblique triangles. Logarithms—the principle of logarithms; multiplication and division by use of logarithms; use of tables; finding powers and roots by use of logarithms; fractional powers.

Mechanisms and machine elements.—Linkages—tracing path of a point in a linkage; laying out linkage problems for different conditions of operation. Cams—motions commonly used; disk cams with reciprocating or rocking followers; positive-motion cams; cylindrical cams; inverse cams; working drawings. Gearing—definitions; types of gears; spur gears; bevel gears; worm and spiral gears; involute and dicycloidal systems; cutting gear teeth; ratchet gearing. Belting—velocity ratio; crowning; stepped pulleys for constant length of crossed and open belts; quarter-twist belts; arrangements for connecting shafts at odd angles. Materials and metal-working operations—founding; forging; machining; punching. Friction and lubrication—causes and effects of friction; coefficient of friction; lubrication; lubricants; methods of lubrication. Screws and screw fastenings—pitch; multiple threads; form of thread; forms of head; machine screws; cap screws; bolts; studs; set screws; nut locks; strength of screws. Other than screw fastenings—keys, pins; cotters, shrink and force fitting; working stresses and factors of safety. Shafting and couplings—materials used and kinds of shafting; strength of shafting under single and combined stresses; horsepower transmitted by shafting; hollow shafting; rigid couplings (sleeve, clamp, flange, Sellers); detachable couplings (lug clutches, friction clutches); couplings for shafts not in alignment (Oldham, Almond, Hooke, flexible disk, and leather link). Bearings—right line bearings; journal bearings; methods of adjustment and alignments; methods of supporting journal boxes on wall, ceiling, and floor; thrust bearings; ball and roller bearings. Pulleys and flywheels—forms and materials; stresses in wheels; proportions of parts; kinetic energy of flywheels. Gearing—Strength of gear teeth; formulas for computing horsepower; efficiency of gearing. Belting and chains—flat belting (materials and application of each); fastenings; horsepower; arrangement of belting and pulleys; care of bolting; cordage-rope driving; wire-rope driving; hoisting chains; chain driving; sprocket wheels; link belt; silent chains.

Strength of materials.—Direct stresses—ultimate strength; elastic limit; factor of safety; working stresses; properties of materials. Bending stresses—moments; reactions; resisting moments; moments of inertia; types of beams; resistance to shear and bending; safe loads; design of beams; comparative strength of beams; standard steel sections. Columns or struts—radius of gyration; column formulas; safe loads; design of columns; use of steel sections; hollow round columns; wooden columns. Elastic deformations—modulus of elasticity; deformations under direct stresses; deflections of beams; twists in shafts; temperature stresses. Reinforced concrete—concrete and steel; compound bars; reinforced columns; reinforced beams; design of beams. Torsion—polar moments of inertia; formulas for torsion; shafts to transmit power; solid and hollow shafts; shaft couplings. Strength of cylinders—riveted joints; lap joints; butt joints; spacing of rivets.

Sheet-metal drafting.—Regular geometric figures intersected by a plane—gutter and cornice miters; ventilating flues; pipe elbows; funnels; exhaust flues; boot legs; boiler smoke-flue connections. Intersections of geometric figures—steam dome; conical eave-trough outlet; conical foot for hot-air pipe; coffee-pot; hopper and chute; ventilator head. Triangulation—transition piece; smoke-flue connection; forge hood; inverted Y-boiler breeching; automobile cowl; footpiece for hot-air stack. Miscellaneous problems—cornice work; bay-window soffit; pedestals; skylights; ship funnels; sheet-metal spheres and other surfaces of double curvature.

Elements of mechanics.—Concurrent forces—components; resultants; conditions of equilibrium; resultants of concurrent forces; parallelogram of forces. Noncurrent forces—

parallel forces; moments; resultants; couples; parallel forces in space; centers of gravity; stable and unstable equilibrium. Resistance and work—friction; coefficients of friction; motion on inclined surface; work against friction. Simple machines—lever; compound lever; inclined plane; wedge; screw; pulley; differential pulley; efficiency of machines. Gravity and motion—velocity and acceleration; vertical and oblique fall; potential and kinetic energy; motions of projectiles; composition of velocities. Inertia and rotation— inertia and energy; centrifugal force; revolving bodies; rolling bodies; pendulums.

ELABORATION OF ORIGINAL PLAN

Additional data to be included in the plan of November 7 were submitted in memorandum form to War Department December 4, 1917. The memorandum is as follows:¹⁹

DIVISION OF RECONSTRUCTION AND REHABILITATION OF DISABLED SOLDIERS, SURGEON GENERAL'S OFFICE

The division of reconstruction and rehabilitation in the Surgeon General's Office is arranging for the functional restoration and reeducation of the disabled soldiers. This division has now been in operation for almost four months. A definite program of action has been developed and the necessary studies and plans connected with this problem are now nearing completion. In order to secure your ratification of these plans and to set forth the important details of our program, the following outline is submitted:

I. DEFINITION AND PURPOSE

a. Physical reconstruction consists in applying all medical and surgical measures which will functionally restore the disabled to as near normal as possible. Rehabilitation consists in training the disabled man to again be a productive agent in spite of his handicap.

b. All kinds of mechanical appliances and shops of light occupations will be installed in connection with hospitals to assist in this functional restoration.

c. The reeducation of disabled members and the vocational training of men so disabled that they must learn a new occupation by the methods necessary to start this rehabilitation. They must begin as soon after the injury as possible. In addition a man must be carefully supervised until complete rehabilitation has been accomplished.

1. In England medical reconstruction is completed before the men are discharged from service, but vocational training is voluntary, with the result that only 15 per cent are choosing this training.

2. By military control is not meant the strict Army discipline or assuming the right to dictate as to his training without considering the man's individual desires, but rather the man must be made to understand that before he is discharged from the Army he is to be functionally restored as far as possible and is to receive proper training that will enable him to overcome his handicap. Each case, however, must be handled as an individual.

II. PRESENT ORGANIZATION OF THE DIVISION OF RECONSTRUCTION

a. The ranking officer is supervising all the work of the department and is coordinating the plans for special reconstruction work of the various specialists' divisions of the Surgeon General's Office (as the blind, the orthopedic cases, etc.).

b. An industrial surgeon with rank of major is making a complete survey of the handicapped in occupations in this country, a study of the reconstruction work in other countries, and is planning for the practical application of reconstruction methods now being used in certain industries to our problem for the handicapped soldiers. Two additional specialists in this work will soon be added to the office staff.

c. An industrial vocational expert with rank of major is planning the technical and mechanical work in connection with our curative shops and for the vocational training in industrial lines of the disabled soldiers.

d. A commercial vocational expert with rank of major is making similar plans for schools and training in this line.

e. An agricultural vocational expert with rank of major is planning for the technical and practical training in this line.

f. An architect with rank of captain is drawing all the plans for the general and special reconstruction hospitals.

g. Two officers with rank of captain are assisting the ranking officer in choosing proper locations and in establishing these hospitals.

h. The ranking officer is working in connection with the "department of special hospitals" in establishing these hospitals.

III. ORGANIZATION OF SPECIAL RECONSTRUCTION WORK IN OTHER DIVISIONS OF THE SURGEON GENERAL'S OFFICE COORDINATED WITH THE GENERAL RECONSTRUCTION PLAN

a. Reconstruction of the blind:

1. An eye specialist has about completed his plans for special hospitals and special vocational training of all blind soldiers. This work is dovetailed in with the general reconstruction program.

b. Reconstruction of the orthopedic cases:

1. Specific plans for reconstruction of this class of patients are being worked out in the orthopedic division and coordinated with the general plan.

2. Special orthopedic departments will be established in the general hospitals, with fitting rooms for artificial limbs and special types of work for training.

c. Reconstruction of the nervous and mental cases:

1. A psychiatric specialist has been assigned to the special reconstruction problems connected with this type of cases and is working in connection with the general reconstruction division.

d. Reconstruction of the general medical cases.

e. Reconstruction of the general surgery cases.

f. Reconstruction of other special surgical cases.

Special reconstruction plans in these three divisions are to be organized and coordinated with the general reconstruction work.

IV. RECONSTRUCTION HOSPITALS

a. Plans for establishing general and special reconstruction hospitals in the 16 draft districts of the country are rapidly being completed.

b. Plans for the receiving and distribution of the disabled soldiers is also outlined in that memorandum.

1. These will be of the type and character described in the original memorandum submitted for your approval.

V. CURATIVE SHOPS

a. Shops and appliances suitable for light work will be established in connection with every hospital.

1. For purposes of retraining disabled members.

2. For psychotherapy.

3. For productivity and to begin the training of men for new occupations.

VI. VOCATIONAL TRAINING CENTERS

a. Plans for establishing certain types of vocational training, as schools, shops, agriculture, in connection with at least one of the general hospitals in each district are being made.

b. Connections with already established schools for purposes of vocational training are being made.

c. Practical training will be given in industries, trades, commercial lines, and agriculture by placing the men in already established concerns.

d. Many of the men as soon as their medical reconstruction is completed will reenter the employ of their old concerns for their old jobs or to be trained for new work. Proper supervision of these cases is now being arranged.

VII. WORK NOW BEING DONE IN THE RECONSTRUCTION DIVISION

a. Formulating the various plans for reconstruction of disabled and establishing the hospitals as above outlined.

b. Studies of all the reconstruction and rehabilitation work of other countries and a careful abstract and filing of these studies.

c. A practical, thorough survey of the industrial, agricultural, trades, commercial, and professional fields of this country is being made to ascertain—

1. Occupations of and types of work now being done by handicapped individuals, classified according to specific disabilities.

2. Occupations in which handicapped individuals with specific disabilities are most successful.

3. Occupations and specific work which will be available for our handicapped soldiers classified according to their specific disabilities.

4. Classification of occupations in which specialized training is necessary.

5. Classification of occupational hazards to ascertain if specific disabilities will increase these hazards.

6. The economic demands of each occupation.

d. Arranging for the location of and establishing of a large number of general and special reconstruction hospitals.

e. Arranging for the establishing of all types of curative shops and vocational training centers.

f. Plans are being made for creating the proper mental attitude in the disabled men themselves.

1. A book is now being prepared for this purpose, and plans for a general educational campaign among the disabled are about completed.

g. The Medical Corps.—A book is being prepared to fully acquaint every medical officer with our plans for reconstruction and his duties in connection with this work.

i. Plans for wide publicity of our reconstruction program are now being completed.

VIII. PLACING THESE MEN BACK INTO CIVIL LIFE AND INTO SUITABLE OCCUPATIONS

a. The actual work of this division is completed when military control ceases. It is recommended that the man be not discharged from the Army until his medical reconstruction is completed and he is able to return to his former occupation, or until his medical reconstruction and his training for some new occupation (made necessary because of nature of disability) is completed.

b. It is recommended that the actual placing of these men shall be done by a central or national employment bureau such as that already established. An employment man should be on the staff of this division to act as our representative between the discharging of these disabled soldiers and this national employment bureau.

IX. FINAL SUPERVISION UNTIL REHABILITATION IS ASSURED

a. The war risk insurance act provides for certain amount of both medical and economic supervision over each discharged disabled soldier.

b. The personal and social supervision is provided for in the plans of the civilian relief division of the American Red Cross.

X. EXTENSION OF WORK

It is desirable to make our reconstruction program so comprehensive that—

a. It will be applicable to the disabled of the Navy.

b. Applicable to the disabled in the industrial Army (meaning the employees in allied military occupations).

c. And can be extended and made a permanent plan for the reconstruction and rehabilitation of all civilian disabled workers in the future.

XI. NEED FOR FURTHER ORGANIZATION

In order to insure efficiency and cooperation among all officers working on reconstruction and rehabilitation of war injured, it would be necessary for this department to be organized at once as a distinct division in the Surgeon General's Office. Efficiency demands the coordination of work of all officers dealing with reconstruction under one chief.

XII. ADVISORY BOARD

Many governmental and private agencies are working on various problems connected with reconstruction and rehabilitation. Some of these agencies are formulating plans favorable to their handling most of this program, while others are planning to carry on certain angles of the problem which they assume belong to them. In other words, these different agencies, unless coordinated, are liable to disorganize our whole program.

England, France, and Canada have been handicapped in the efficiency of their work of reconstruction by having it divided up among several different committees and different civil governmental agencies. Canada is gradually being forced to sweep out many of these committees and completely reorganize this branch of its work. Facts and statements of good English authorities point to the importance of keeping our reconstruction program under military control.

We recognize the value of having the advice and aid of any governmental and private agencies which are directly concerned in reconstruction work. Further, reconstruction and rehabilitation of the war crippled is a national problem and one which involves other branches of the National Government besides that of the Surgeon General's Office. In order to keep the medical and surgical work and the vocational training of these disabled men in the Surgeon General's Office, where it rightfully belongs, and at the same time to make our entire program of reconstruction so comprehensive that it will include these other agencies, we recommend the appointment of an advisory board directly under the Secretary of War or under the National Defense Council.

The board suggested would include: (1) Surgeon General of the Army as chairman, (2) Surgeon General of the Navy, (3) Surgeon General of the United States Public Health Service, (4) representative of the medical section of the National Defense Council, (5) representative of American Federation of Labor, (6) representative of big industries, (7) representative of educational bureaus under Federal Government, (8) representative of American Red Cross, civilian relief division, (9) representative of National Employment Bureau, (10) representative of War Insurance Bureau.

XIV. HOSPITALS

a. As outlined in former memorandum, we recommend establishing a general reconstruction hospital in every draft district of the country, and later, if number of disabled demand, establishing other general hospitals in these districts, the hospitals to be located, as far as possible, near industrial and commercial centers for purposes of training.

b. Special hospitals to be established in every district, except when numbers are so small as to justify only one such hospital—(1) tuberculosis sanatoria; (2) mental and nervous sanatoria; (3) blind and deaf hospitals.

XV. VOCATIONAL SCHOOLS AND SHOPS

These are to be established in connection with each general hospital and where necessary at the special hospitals and further elaborated in special memoranda attached.

XVI. TEACHING FORCE

In each hospital we recommend that an educational director be placed. That director should be a commissioned officer, rank of captain.

a. Teaching corps be established under an office of teaching personnel in the division of reconstruction.

b. It may be necessary in order to secure suitable teachers to take some men from the drafted Army.

c. Salaries for teachers should be from \$1,200 to \$3,000.

A SUGGESTED PLAN FOR THE ORGANIZATION OF THE RECONSTRUCTION TEACHING CORPS

It is respectfully suggested that there be established in the division of special hospitals and physical reconstruction of the Office of the Surgeon General a subdivision to be known as the reconstruction teaching corps.

The object of this subdivision is to supply the teaching necessary for the complete rehabilitation of the disabled soldiers during their period of convalescence and reeducation in the Army.

This corps will include (1) men selected from commerce, industry, and agriculture because of their practical experience and general ability in the special line which they are to teach; (2) crippled men from civil life who have been successful in commerce, industry, or agriculture; (3) capable injured men returned from active service who have sufficiently recovered; (4) successful teachers and mechanics selected from the draft army, if a sufficient number can not be obtained otherwise.

Persons selected for this corps may be assembled at some convenient point for three to six weeks of intensive instruction in special methods of teaching suitable to hospital instruction.

A chief personnel officer under the direction of the chief of the division of special hospitals and physical reconstruction should have charge of the teaching personnel. He will by reference to prescribed report and returns keep himself constantly informed as to the numbers, distribution, and competency of the individual members of the subdivision and its state and condition as a whole; he will keep constantly a list of candidates for the subdivision, will conduct the necessary correspondence relating to his duties, and will make recommendations for appointment when vacancies occur. The list of available candidates kept by the subdivision will contain only the names of persons who shall have fulfilled the requirements set up by the special education officers of the division of special hospital and physical reconstruction.

APPOINTMENT

Members of this corps shall be appointed by the Surgeon General on recommendation of the chief of the division of special hospitals and physical reconstruction.

Members of this corps when assigned to particular hospitals shall work under the immediate direction of the director in charge of the education at the hospital.

Members of this corps traveling under orders are entitled at public expense to their transportation, traveling allowance, baggage transportation, as provided in Army Regulations. Travel to and from points beyond the limits of the United States will be by Army transports in all cases where practical. When assigned to duty at military establishments, quarters subsistence will be provided.

PROPOSED PLAN FOR PROVIDING PROFESSIONAL EDUCATION TO DISABLED SOLDIERS

It is recognized that professional training can be given only in colleges or teacher-training schools of recognized standing. All experience goes to show that it is very important that the man who is to enter one of the professions shall have completed a course in a professional college of recognized standing.

In providing professional instruction the plan is to take advantage of the opportunities offered by existing schools giving professional courses. A careful survey is therefore being made of all of the recognized schools and colleges giving professional training to learn what courses are offered in each college, the length of the course, the tuition, the living conditions, the amount necessary to maintain a student a year in the college, and all of the information which is needed to determine what school a man shall attend.

Inasmuch as this is an enterprise of the Government, it is proposed to utilize, in so far as possible, those institutions which receive annual grants of money from the Government. When these facilities have been utilized to their full extent, it is proposed to appeal to State institutions and later to semipublic institutions which are endowed from private sources.

A careful survey of each soldier's general and educational qualifications will be made in the receiving hospital by men chosen from various schools and colleges. Only those men who have had the equivalent of a high-school course and are otherwise eligible to entrance in a

recognized college will be assigned to professional courses. If the man is retained in the Army, his pay as a private will support him during his college courses. It is possible that educational institutions will have scholarships available which will make it unnecessary for the regular tuition to be paid. In nearly all of the agricultural and mechanic arts colleges receiving Federal grants of money tuition is free to residents of the State. As the man is still in the Army, it will be possible to have monthly reports of his progress in the institution submitted to the proper authorities in order that the Government may be assured that he is taking full advantage of the opportunities afforded him.

It is recommended that the man be retained in the Army until the completion of the professional course in the college. He should then be discharged from the Army, and will enter civilian life fully equipped to earn his own living in the profession for which he has been trained.

MEMORANDUM OF SUGGESTED PLAN FOR TRAINING DISABLED SOLDIERS FOR AGRICULTURAL PURSUITS

Group I.—Men with agricultural experience and a partial education in scientific agriculture who desire to complete such education.

Group II.—Men with agricultural experience but with no agricultural education who desire to obtain such education—either of secondary or college grade.

Group III.—Men with or without agricultural experience who desire to fit themselves for practical work in some agricultural pursuit.

Group IV.—Men whose principal occupation will not be agricultural but who will engage in home gardening, fruit growing, poultry keeping, etc., to supplement income from other sources.

I. PRELIMINARY INSTRUCTION IN HOSPITALS

a. For Group I.—Directed individual studies in special agricultural subjects according to the needs of the individuals carried on until men are in physical condition to be sent to agricultural schools or colleges, together with practice in gardening and shop work for therapeutic purposes.

b. For Groups II and III.—Practical gardening or poultry work in the hospital garden or poultry plant, both for curative and instructional purposes, with supplementary classroom instruction carried on until the men are in physical condition to be sent to agricultural schools or colleges or placed with market gardeners, poultry men, or general farmers to gain experience.

c. For Group IV.—Practical gardening or poultry work with supplementary classroom instruction until the men are either discharged or placed in schools or shops for education in their principal occupation.

All groups should have instruction and practice in the hospital curative work shops in elementary carpentry not only for curative purposes but also for reeducation in the use of carpenter tools and in making simple farm implements.

Groups II and III should have classroom instruction in sciences allied to agriculture, such as chemistry, biology, etc.; also in related general education when necessary.

II. FURTHER INSTRUCTION IN SELECTED STATE AGRICULTURAL COLLEGES (AND OTHER AGRICULTURAL SCHOOLS IF NECESSARY)

a. For Group I.—Men should be placed in regular college classes in institutions selected with reference to the particular subjects desired by the individual men and for other considerations, such as tuition, nearness to home, etc. The men should pursue approved courses and be under general supervision of the Surgeon General.

b. For Group II.—In special classes taught by approved instructors employed by the colleges in work below college grade and suited to the needs and abilities of the men. Each course should consist of a large amount of practical farm work in the special phases of farming desired by the men with laboratory and classroom instruction in the necessary allied subjects. The courses would be from three months to two years in length, depending upon the particular

work. (Preparation for dairying work would require three months, for general farming one to two years.) Similar courses for farmers are now given at the majority of the State agricultural colleges.

c. For Group III.—In the special classes at the colleges arranged for men of Group II, where such courses seem desirable; in other cases individual men could be placed on approved farms to gain experience in some specified agricultural pursuit, such as fruit growing, market gardening, dairy work, etc.

III. INSTRUCTION

a. For hospitals with approximately 20 men or less enrolled for education in agriculture one instructor will be required. If possible, he should have had technical agricultural education equivalent to four years in a standard agricultural college and be a specialist in either market gardening, poultry, or in both. If more than 20 men are enrolled, 2 instructors will be required. One should be a specialist in market gardening, the other in poultry. Only men with practical experience in these branches should be employed.

b. Instruction in the sciences allied to agriculture, such as chemistry, botany, etc., should be given by the instructors in agriculture.

c. Competent instructors in agriculture for the hospitals will be difficult to find at the present time on account of the large number of agricultural schools being established this year, stimulated by the Smith-Hughes Vocational Education Act, and the large number of men suitable for agricultural teachers employed this year for the first time as county agricultural agents paid by the Federal appropriation to increase food production. An immediate canvass should be begun to locate suitable men. It may be necessary to look to men now in training at cantonments.

IV. SPECIAL PREPARATION FOR INSTRUCTORS

However well trained and experienced in agriculture men obtained for instructors may be, the majority will need from three to six weeks' intensive instruction in special methods of teaching suitable to hospital instruction under a qualified person obtained for this purpose. They should be assembled for instruction at the earliest possible date. The person obtained to instruct them may be afterwards employed as an adviser to the proposed examining board at the receiving hospital relative to individuals desiring education for agricultural pursuits.

V. SUPERVISION AND CONTROL

a. Surgeon General's Office, War Department, Washington: General supervision, assignment of men, approval of plans, courses of study, methods of instruction, living conditions, discharge of men, etc.

b. Department heads and agricultural teachers in each hospital will be under the officer in charge of reeducation for the hospital.

c. Men from Groups II and III assigned to agricultural colleges should be in groups of 20 to 60 and should be provided with living quarters, sleeping quarters, and a study hall in temporary barracks erected on the college grounds under the immediate charge of a resident military officer.

d. All men should be kept in Army service until education is completed.

VI. ASSISTANCE IN BECOMING FARM OWNERS

Provision should be made if possible, to assist the men trained for agricultural pursuits to become landowners and farm operators rather than farm laborers or renters. Probably the most feasible plan to bring this about is for the Government to purchase available farm lands in many different parts of the United States in tracts of several hundred acres, divide them into 30 or 40 acre farms, erect the necessary permanent improvements, and sell to discharged men under a long-term payment plan, similar to the workings of the Danish "Small holdings act" or the "Irish congested districts." Under both of these annual payments are made by the purchasers at the end of each year, the payment covering interest and a fixed amount on the principal. In the Irish plan "Agricultural overseers" are employed for each group of approximately 200, whose work is primarily of an advisory nature. The results of the employment of these overseers has proved the wisdom of their employment.

MEMORANDUM OF PLAN FOR VOCATIONAL REEDUCATION OF DISABLED SOLDIERS ALONG TRADE, TECHNICAL, AND MANUFACTURING LINES

This training should begin at the earliest possible time so that the disabled men will not have an opportunity to acquire habits of idleness. To this end an occupational and social survey covering the man's previous education, industrial history, etc., should be made at the earliest possible moment, certainly not later than at the main receiving hospital in his country, before if possible.

We shall probably have to deal with the following groups:

I. Men with trade experience but with little if any general and related technical education. These men can be returned to their former occupations or through special trades, technical, or scientific education which may be given, they can be returned to a related or similar position in the same trade or industry.

II. Men with trade training or industrial experience who have also had some technical and scientific training. Such men can be returned to the former trade or industry in the same position or through further trade, technical, or scientific training can be placed in executive work in the same industry or similar industry.

III. Men without trade or technical experience who will wish to be fitted for some trade or technical occupation.

IV. Men who have been in one trade who, because of their handicap or other reasons, do not wish to follow their former trade and will wish to be trained for some other trade occupation or technical profession.

V. Men of technical ability who can be trained to run some small business of their own where they will to a large extent be relieved from industrial competition in plants of large-scale production. Example of such small business: Saw filing, lock repairing, etc.; shoe repairing, harness and other leather goods; tailoring, cleaning, pressing, etc.; watch and jewelry repairing.

VI. Men who have entered trade or technical courses of intermediate and college grade who will wish to complete their education along these lines.

PLAN FOR GIVING THE TRAINING

I. In the hospitals:

(a) Prevocational instruction in curative work shops (buildings, equipment, tools, and teachers needed).

(b) Related general education to make it possible for the man to handle the simple reading and calculations necessary in his occupation (rooms, blackboards, books, and teachers to be provided).

(c) Related technical instruction: Shop talks, demonstrating of tools, methods of production, related drawing, mathematics, science, and business management as related to production. (Needed, special typical tools, drawing-rooms, classrooms, laboratories, books, teachers.)

(d) Special trade instructions where it is not found possible to send the men to existing schools or commercial shops. Examples: Tailoring, lock repairing, saw filing, shoe repairing, etc.

II. In existing schools in the sections served by the hospital: We should not make unnecessary duplication of equipment, but should use existing school plants so far as possible, thus getting the advice and experience from certain well-established institutions. Only such schools should be selected as have equipment and teachers who are able to give instruction on a practical commercial or productive basis.

NOTE.—The men sent to these schools might well be those who have had no previous experience in a given line of work, while those sent to shops or training centers should be men who before their injury had worked in the particular trade of which they are returned.

III. In selected industrial plants or group of plants which may be used as United States training centers:

(a) Men while so placed will be under Army supervision and direction.

(b) Courses and methods to be worked out in cooperation with the industry or individual plant, care being taken that the man is not exploited.

(c) The assignment of disabled men as assistants to workmen for observation and practice.

NOTE.—This will necessitate setting apart machines in the plant for practice in order not to interfere with production. These to be used for lectures, demonstrations, and experiments by men under training.

(d) Experimenting in cooperation with the industrial surgeons to find the best artificial appliances which will enable disabled men to handle the special work or tools of the job. It has been amply demonstrated by the cooperative work of Cincinnati, Ohio, Fitchburg, Mass., and other places that trade and technical training can be successfully given in commercial establishments.

IV. Teachers, supervisors, and other specialists: There is a well-known shortage of teachers and supervisors. The existing schools have great difficulty in obtaining such men. The situation has been made still more acute by the exceptional opportunities in industry. The Shipping Board and Federal Board for Vocational Education have recently taken a number of the more experienced men. A few men may be had from existing educational institutions. Such men will have to fill the more responsible administrative positions. The great bulk of the teachers and assistants will have to come from the National Army in the various cantonments. A few trained teachers will probably be found in this group. There is probably a sufficient number of mechanics and technicians in the cantonments who can be trained to be teachers and supervisors. It is desirable to select men and begin their training at once. We can do this in part by cooperating with the existing schools. From among the rehabilitated soldiers, as fast as the disabled soldiers can be rehabilitated they will make the most effective teachers. Men who have been taken from the National Army for teaching service can be returned to active service as fast as their places can be so filled by returned men.

V. Courses and methods: Use the courses and methods of instruction already developed in the existing vocational and technical schools and commercial plants, adapting them to the special needs of the disabled men.

VI. In carrying on all of this work it will be necessary to have advisory committees to the educational director in the different sections served by the hospitals; such committees to represent the schools, employers, employees, and placement agencies in the section.

VII. Discharge of men upon recommendation to the Surgeon General when they are ready to hold a place in industry or be self-supporting.

VIII. Supervision and help before and after discharge by outside cooperating agencies.

On January 5, 1918, the Surgeon General's tentative plan was returned to him by the Secretary of War with the suggestion that a conference be held with representatives of the War Risk Insurance Bureau, United States Public Health Service, General Labor Committee, Interior Department, Bureau of Medicine and Surgery of the Navy Department, Vocational and Educational Commission, and of any other agency related to the work.¹⁹ Since similar plans were being considered by several other departments, it was the desire of the Secretary of War that the Surgeon General present a plan which would introduce unity and coordination in the whole scheme, apportioning, if necessary, to the Army, the Navy, and the Public Health Service their respective functions in the matter.

The conference was held January 14, 1918, with the Surgeon General, United States Army, chairman, and representatives present from the medical section of the Council of National Defense, Medical Department of the Navy, United States Public Health Service, United States Employees' Compensation Bureau, American National Red Cross, War Risk Insurance Bureau, Treasury Department, Federal Board for Vocational Education, Department of Labor, American Federation of Labor, United States Chamber of Commerce, National

Manufacturers' Association, Red Cross Institute for Disabled and Crippled Men, civilian medical profession, medical department of the Canadian Army, and the Office of the Surgeon General of the Army.¹⁹

The chairman appointed a committee of 14, consisting of one member from each department represented, except the Canadian Army, with the representative from the United States Bureau of Education as chairman, to draw up a complete program for reconstruction and rehabilitation of disabled soldiers.¹⁹

After having met several times the committee made the following report, which expresses the plan which the committee recommended:¹⁹

1. As regards the undischarged member of the military or naval forces of the United States, all medical and surgical work necessary to give, as far as possible, functional and mental restoration shall be directly under the executive control of the Surgeon General's office of the respective services. It is understood that when such medical aids as curative work shops and vocational training are needed to accomplish the above, they are included in the medical and surgical work.

2. That when, in the judgment of the Medical Department, the disabled member had reached as complete a state of physical and mental rehabilitation as possible he is to be discharged from the service if unfit for further service, full or restricted, and will pass under the control of such other agency of the Government as was or might be provided to carry on his continued rehabilitation.

NOTE.—It was the sense of the conference that the facilities for treatment in military and naval hospitals should include everything required to enable members of the military and naval services to receive full mental and physical restoration in all cases where this is humanly possible prior to their discharge from the service, and that, save in exceptional cases, this discharge should not take place prior to such full restoration or until its accomplishment seems to be improbable. No regulations should be made or legislation enacted to prevent the use of Army facilities by the Navy by proper arrangements between the two departments, or vice versa, or to prevent the return of discharged members of either service to service hospitals for further treatment under proper authority.

3. That a board shall be appointed by the President of the United States for the control and direction of the work hereinafter described.

4. This board shall have executive control over the phases of the work represented in rehabilitation of the disabled after the medical and surgical work was complete—namely, continued vocational training, when necessary; placing in employment; economic and social supervision, to see that rehabilitation is complete and so remains. It may act in an advisory capacity to the vocational officer on the Surgeon General's staffs, with the view of coordinating all vocational training during convalescence with any continued vocational training that is necessary after the man is discharged from the service.

NOTE.—Paragraphs 1 and 2, with the note under 2, indicate what, in the opinion of the conference, are the proper functions of the Medical Departments of the military and naval services with regard to the matter under consideration. Nothing in any legislation which may be required to carry out the provisions of paragraphs 3 and 4 should be susceptible of an interpretation contrary to the sense of paragraphs 1 and 2, with the note under 2.

5. The following tentative draft of a bill is submitted as indicating the legislation necessary to carry out the work which would be required for members of the military and naval forces after discharge.

The proposed legislation referred to was to provide (a) that all treatment of any kind necessary prior to discharge of any person from the Army or Navy should be under the control of the service concerned; (b) for the establishment of a board for vocational rehabilitation, with power to make provision for vocational rehabilitation of (1) such above-named persons after separation from the service, but whose disability was incurred while in the service; (2)

under certain specified conditions to any of the following: Former service persons whose disability arose after separation from the service; civilian employees of the Government; other civilians; (c) for the repeal of the act establishing the Bureau of War Risk Insurance.

At the second meeting of the conference, January 21, 1918, the report of the committee was adopted, and the recommendation was made to the Surgeon General that he submit the report to the Secretary of War as the recommendations of the conference.¹⁹ In forwarding the report to the Secretary of War on January 29, 1918, the Surgeon General invited the Secretary's attention to a provision in the proposed legislation which would extend the vocational training to all disabled persons, under certain conditions; also, he recommended early authorization to proceed with the development of necessary hospital facilities.¹⁹

When the proposed legislation was referred to the Judge Advocate General of the Army for remark, he recommended disapproval, principally because the work as proposed would be done by the authorized director rather than the board, and there was no provision for his removal in case of dissatisfaction; the provision for extending rehabilitation to persons who were never in the military or naval service made its application so broad that the attempt to enact it into law would almost certainly fail.¹⁹

On February 13, 1918, the Surgeon General recommended to the Secretary of War that the conference be again convened and that the Judge Advocate General be invited to participate.¹⁴ At the same time he reiterated the fact that the problem before the Medical Department was the provision of physical and mental rehabilitation of disabled soldiers before their separation from the service, and urged immediate action on recommendations made to War Department several weeks previously as follows: (1) That no member of the military service disabled in line of duty be discharged until recovery was complete or as complete as could be expected. (2) That physical reconstruction be defined as the completest form of medical and surgical treatment carried to a point where maximum functional restoration, mental and physical, had been secured. (3) That authorization be given to establish reconstruction work in 16 specified hospitals in order to provide 60,000 beds before the winter of 1918-19.

On May 6, 1918, the Secretary of War defined the reconstruction functions of the Medical Department as follows:²⁰

You are authorized to proceed with the scheme for reconstruction of officers and enlisted men of the Army alone without consideration of the other bureaus of the Government involved, this reconstruction to be clearly understood to end at the point where the medical reconstruction ceases—that is, the reconstruction to take place in such cases of officers and enlisted men as come under proper medical treatment by the War Department, leaving for other reconstruction purposes the subsequent treatment after discharge from the care of the Medical Department.

This understanding in the field of work in reconstruction assigned to the Medical Department of the Army did not entirely clarify the situation, since memoranda to the War Department requesting approval of needed hospital construction equipment for physiotherapy, for occupational therapy, and for qualified personnel to administer physiotherapy and curative work in military hospitals were disapproved wholly or in part or were returned by the General Staff for additional information.¹⁹

Despite the delay incident to this confusion, creditable application of all measures included under physical reconstruction was begun early in 1918 at General Hospital No. 2, Fort McHenry; at Walter Reed General Hospital, Washington; and at General Hospital No. 6, Fort McPherson, Ga.

Arrangements were made with the Bureau of Medicine and Surgery, Department of the Navy, May 10, 1918, whereby such sailors and marines as might require reconstruction were to be admitted to reconstruction hospitals of the Army for treatment and training.²¹ The authority for this was confirmed by the Secretary of War on May 27, 1918.

In May, 1918, the functions of the division of reconstruction in relation to the clinical divisions of the Surgeon General's Office were more clearly defined. The section of orthopedic aides was transferred from the orthopedic division to the division of physical reconstruction.¹⁶ All officers on duty in this division as representatives of clinical divisions returned to their proper divisions. The interest which it was necessary for this division to maintain in hospital sites, special buildings for schools, shops, physiotherapeutics, and gymnastics was better secured by the organization therein of a section on architecture and by cooperative relations with the hospital division. In the Surgeon General's Office it was understood that the division of physical reconstruction would furnish to the hospitals which were to function in physical reconstruction the required personnel of officers and enlisted men and reconstruction aides for efficiently carrying on occupational therapy, physiotherapy, gymnastics, sports and pastimes, and social service. In the hospitals it was agreed that the clinical officers would prescribe types of occupational and physiotherapy play and drill required to aid in the physical and functional restoration of the disabled men, leaving to the educational and physiotherapeutic officers the efficient application of the reconstructive measures prescribed. In detail, the physical reconstruction program, as promulgated by the Surgeon General on June 3, 1918, was as follows:²³

* * * * *

2. The Medical Department of the Army assumes that the care of the sick and wounded soldiers is incumbent upon the department. In accordance therewith * * * the division of physical reconstruction has developed the machinery necessary for the special work of reconstruction and this may be summarized as follows:

(a) An administrative personnel which includes the special care of disabled soldiers by the several departments of medicine and surgery with a qualified medical officer at the head of each special department. These departments are general medicine, neurology and psychiatry, tuberculosis, heart diseases, gastrointestinal diseases, skin diseases, general surgery, military orthopedics, head surgery (including blindness, deafness, speech defects, brain surgery, plastic surgery of the head, throat, nose, and ear diseases), venereal diseases, and genitourinary diseases.

(b) Inasmuch as this treatment of diseases and injuries embraces not only anatomical but functional restoration, continued treatment requires the use of physiotherapy. Physiotherapy includes such measures as hydrotherapy, electrotherapy, active physical exercises of all kinds, including military or other drill or modified Swedish movements, and passive exercises such as massage, etc. Functional restoration also requires, in addition to what may be termed "physiotherapy," curative occupation in the form of manual and mental work at the bedside and in shops.

(c) An educational department, the function of which is to develop along modern lines the personnel and equipment necessary to administer occupational therapy.

3. The administrative forces organized in the division of physical reconstruction have been duplicated as to the personnel, including the equipment to administer the reconstructive treatment, in each general hospital where reconstruction work is carried on.

4. The Medical Department of the Army has assigned the following general hospitals for the reconstruction of disabled soldiers:

Insane—St. Elizabeths Hospital, Washington, D. C.; General Hospital No. 4, Fort Porter, N. Y.

Functional neuroses (nervous diseases)—Plattsburg Barracks, N. Y.; Fort Des Moines, Iowa.

Epileptics—Plattsburg Barracks, N. Y.

Pulmonary tuberculosis—Fort Bayard, N. Mex.; General Hospital No. 16, New Haven, Conn.; General Hospital No. 17, Markleton, Pa.; United States Hospital, Waynesville, N. C.

Cardiovascular diseases—General Hospital No. 6, Fort McPherson, Ga.; General Hospital No. 9, Lakewood, N. J.; Fort Des Moines, Iowa.; Corpus Christi, Tex.

Chronic rheumatism—General Hospitals No. 6 and No. 9; Fort Des Moines, Iowa.

Disabilities due to being gassed—General Hospital No. 2, Fort McHenry, Md.

Other general medical cases—Corpus Christi, Tex.; General Hospitals No. 6 and No. 9; Walter Reed General Hospital; Fort Des Moines, Iowa.

Those requiring orthopedic treatment—General Hospitals No. 6 and No. 9; Walter Reed General Hospital; Letterman General Hospital.

Amputations—Walter Reed General Hospital, Washington, D. C.; Letterman General Hospital, San Francisco.

Total deafness, speech defects, and purulent otitis media—General Hospital No. 11, Cape May, N. J.

Blindness, or near blindness—General Hospital No. 7, Roland Park, Baltimore Md.

Venereal disease and its sequelæ (where venereal disease is major disability)—General Hospital No. 5, Fort Ontario, N. Y.

Wounds and injuries or other surgical conditions of the genitourinary system (where the injury or wound is major disability)—General Hospitals Nos. 2, 6 and 9; Walter Reed General Hospital; General Hospital No. 2, Fort McHenry, Md.; Letterman General Hospital, San Francisco; Corpus Christi, Tex.

Wounds or injuries involving the head, including eye, ear, nose and throat, face and jaw—General Hospital No. 11, Cape May, N. J.

Special services of diabetes—General Hospital No. 9, Lakewood, N. J.; Fort Des Moines, Iowa; Letterman General Hospital, San Francisco.

The partial or complete personnel and the full minimum equipment necessary for curative occupation is in active operation at General Hospitals No. 2, 6, 9, 11, 17, and Walter Reed.

5. As rapidly as conditions permit the reconstruction work at all of the hospitals named is being developed. More or less delay has occurred because of the difficulties embraced in the necessary construction of barracks, workshops, etc.

6. At New York and Newport News, the ports of embarkation, the necessary organization for classification and rapid distribution of the disabled men from overseas reconstruction hospitals has been completed and is in satisfactory working condition. The division surgeons have been ordered to report the individual cases of disability who may be reconstructed, now in the base hospitals of cantonments, that they may be transferred to the general hospitals where reconstruction work is carried on.

7. The above statement of the organization of the administration and the continued treatment of disabled soldiers is set forth in this connection to indicate the understanding of the Medical Department of the Army as to the authority of the department in caring for the sick and wounded soldiers and to indicate that physical reconstruction is now in actual operation.

Repetition of the statement gives emphasis to the opinion of the Medical Department of the Army that no soldier should be discharged from the Army until he shall have received the continued treatment which will entirely restore him to health or as nearly restore him as the nature of his disabilities permits.

8. The Medical Department of the Army has within its personnel, in addition to its regular medical officers, the best-qualified men of the United States in medicine and surgery, including the specialists. These are serving in the Medical Reserve Corps of the Army and in the National Army.

9. Attention is directed to the fact that to carry on the necessary treatment in an efficient way the Medical Department of the Army must have full and undivided authority over the disabled soldier during the entire period required for his cure.

Such aid as may be rendered by other Federal agencies or by State, municipal, and private agencies in a cooperative way will be welcomed by the Medical Department of the Army with the full and definite understanding that such aid will be rendered to the Medical Department of the Army only upon the invitation of the Surgeon General.

POLICY OF PHYSICAL RECONSTRUCTION ESTABLISHED

The recommendations of the committee of 14, forwarded by the Surgeon General to the Secretary of War on January 29, 1918, were finally approved by The Adjutant General on July 31, 1918, as follows:²⁴

The general policy of physical reconstruction as proposed by the Surgeon General's Office for the purpose, primarily, of effecting the maximum restoration of disabled soldiers, using manual and mental work as a curative agent, and, incidentally, of training and educating them for further useful work in the Military Establishment, is approved, with the understanding that such incidental training will not involve the Government in large expenditures and elaborate installation of shops and apparatus, and providing that all existing facilities, both military and civilian, for training and educating the soldier toward the end in view shall be used to the fullest extent.

The fundamental policies and plans for the physical reconstruction of disabled soldiers having been finally approved by August 1, 1918, and the actual performance sufficiently tested in hospitals, the Surgeon General's Office was then prepared to proceed with the work on any scale which the future might demand.

It was necessary for the greatest success of the undertaking to educate not only the Medical Department but the whole Army and the public as well in the possibilities opened to the disabled soldiers by this project, for the degree of ultimate accomplishment depended on thorough appreciation and support by all concerned; therefore, the Surgeon General published in the *Official Bulletin* of August 1, 1918, the following plans for physical reconstruction of disabled soldiers in the general military hospitals:²⁵

PLANS FOR PHYSICAL RECONSTRUCTION OF DISABLED SOLDIERS IN THE GENERAL MILITARY HOSPITALS ARE ANNOUNCED

LIST OF INSTITUTIONS WHERE REHABILITATION WORK WILL BE CARRIED ON—MANY KINDS OF TREATMENT TO BE EMPLOYED AND MANY VOCATIONS TO BE TAUGHT

The following statement is authorized by the War Department:

The Surgeon General, with the approval of the General Staff, announces the completion of plans for the physical reconstruction of disabled soldiers in the general military hospitals. These plans are formulated with a view to close cooperation with the War Department committee on education and special service in the work of restoring men to full or limited military service, and with the Federal Board for Vocational Education, which is authorized by the law to provide vocational training for disabled men after their discharge from the Army and Navy.

The records of 516 cases treated in four hospitals show 134 men able to return to full military duty, 210 fit for limited service, and 172 who are eligible for discharge. In the last

group, 12 are classed as helpless or institutional cases, 121 are able to return to their former occupations, and 39 will need further training to fit them for earning a livelihood. These figures show the division of responsibility in the work of reconstruction.

Most pressing need

The task of fitting men for further military service is at present the most pressing need, because wherever an able-bodied man behind the lines can be replaced by one less fit physically but vocationally capable a soldier is gained for active duty. The reconstruction work in the hospitals, therefore, will emphasize technical training in all lines capable of adaptation to the physical limitations of disabled men and in which employment will act as a therapeutic agent. When play and work and study will help a man to get well, this kind of medicine will be prescribed for the patient. If the work he does leads to further service in the Army or to better prospects in civilian life, so much the better.

Hospitals designated

The Surgeon General has designated the following general military hospitals for the work of physical reconstruction: Walter Reed General Hospital, Washington, D. C.; General Hospital No. 2, Fort McHenry, Md.; General Hospital No. 3, Colonia, N. J.; General Hospital No. 6, Fort McPherson, Ga.; General Hospital No. 7, Roland Park, Baltimore (for the blind); General Hospital No. 8, Otisville, N. Y.; General Hospital No. 4, Fort Porter, N. Y.; General Hospital No. 9, Lakewood, N. J.; General Hospital No. 11, Cape May, N. J.; General Hospital No. 16, New Haven, Conn.; General Hospital No. 17, Markleton, Pa.; Letterman General Hospital, San Francisco, Calif.; United States Army Hospital, Fort Des Moines, Iowa.; Plattsburg Barracks Hospital, Plattsburg Barracks, N. Y.; and General Hospital, Fort Bayard, N. Mex.

Policy to be followed

The policy to be followed in these hospitals, as announced by the Surgeon General, is that, hereafter, no member of the military service disabled in line of duty, even though not expected to return to duty, will be discharged from service until he shall have attained complete recovery or as complete recovery as may be expected when the nature of his disability is considered. In furtherance of this policy, physical reconstruction is defined as complete mental and surgical treatment carried to the point of maximum functional restoration, both mental and physical. To secure this result, all methods recognized by modern medicine as conducive to cure will be utilized. In other words, not only the ordinary means of medicine and surgery, including all specialties, will be utilized, but also physical measures such as are employed under physiotherapy, including hydro-, electro-, and mechano-therapy, active exercises, indoor and outdoor games, and passive exercise in the form of massage. Provision in the form of adequate buildings and equipment for physiotherapy has been adopted in each of the hospitals.

Functional restoration final aim

Modern medicinal treatment does not end with physical cure. Functional restoration is the final aim of the modern physicians and surgeons. It is conceded that the physical rehabilitation of disabled men is peculiarly dependent upon their mental attitude. The more serious the disability, the greater the danger of mental depression and an indisposition to respond to medical and surgical treatment. The educational work should begin, therefore, at the moment when the man has arrived at the stage where he begins to worry about his future, whether in this country or overseas. The first problem is to divert his attention by simple recreation, through reading, pictures, games, handiwork occupations, and the like, with a view to securing a genuine interest in the attainment of some worthy end—the end most certain to hold his attention and to claim his best efforts in his future vocation. Hence, by gradual steps, he may be induced to supplement his previous vocational experience by academic, scientific, or technical instruction, or to choose a new vocation and begin preparation for it, if such a course is necessary.

Need of "cheer-up" work

The need of "cheer-up" work in the hospitals extends to all who are mentally capable of planning for their own future. This means a relatively large proportion of the entire number. The beginning is made at the bedside with handicrafts of various kinds, grouped under the term "occupational therapy." When the man is able to leave the ward and can be benefited physically by technical training, he has the opportunity of working at specific trades, either in the curative workshop in specially provided classrooms or out of doors.

The teachers for this work have been secured from the convalescent disabled soldiers who are already skilled in their vocations and from the enlisted personnel of the Army secured by transfer or by induction of registrants disqualified for general military service but qualified for special limited service. These instructors work under the direction of educational officers chosen for their professional standing in civil life and commissioned in the Sanitary Corps of the Medical Department. The General Staff has just authorized commissions for 119 educational officers for this purpose.

Three classes of disabled soldiers

From the military standpoint, disabled soldiers may be placed in three general classes:

- (a) Those who can be restored to full duty.
- (b) Those who can be fitted for limited service.
- (c) Those disabled to the extent of unfitting them for further military service.

It is the announced policy of the Surgeon General that patients of the first class (a) should have, when circumstances warrant it, the benefit of therapeutic treatment through play, work, and study, as may be prescribed by medical officers, in order that their morale may be stiffened, their special skills improved, their future usefulness increased, and their recovery hastened.

Patients of the second class (b) should have, whenever conditions permit and the medical officers approve, such specific training—physical and vocational—as will, in the judgment of the educational officers, best fit such patients for limited service of a particular kind. At present patients are being trained in general hospitals for limited service as general and vocational teachers, typists, printers, tailors, cobblers, harness makers, welders, motor mechanics, telegraphers, photographers, telephone operators, cooks, storekeepers, electricians, etc.

List to be extended

The list will be extended, with the advice and cooperation of the committee on education and special service of the War Department, to meet other needs as they arise. In connection with the large general hospitals there is abundant opportunity for practice in many trades and occupations. At Fort McPherson, for example, practical experience can be gained in 20 different trades. Moreover, there is immediately adjacent to the hospital a large quartermaster's mechanical repair shop, covering all phases of mechanical repair and construction, to which men can be assigned for limited service or to gain experience.

Patients of the third class (c) should be encouraged in every possible way to accept the benefits accorded them for vocational training by the Federal Board for Vocational Education. To this end they should have, while in the hospital, such physical training and general education as will best promote their physical reconstruction and at the same time contribute most to their vocational training. Patients who do not elect or who are not eligible to continue their education under the Federal board should receive such training as the medical and educational officers deem best in each individual case.

MODIFICATION OF RECONSTRUCTION PLANS INCIDENT TO THE ARMISTICE

The plans for reconstruction, prior to the beginning of the armistice on November 11, 1918, had been based on the expectation of a more or less regular increase in the volume of reconstruction cases due to battle casualties. The armistice, however, changed conditions markedly, as plans for the early return

of all transportable invalided men were announced shortly after its beginning,²⁶ thus necessitating a speeding up of the reconstruction program; therefore, the Surgeon General, on December 10, 1918, submitted a memorandum on the subject to the War Department.²⁶ The Surgeon General's memorandum reviewed the announced plan for the reconstruction of disabled soldiers; called attention to the fact that the requests for the construction of curative workshop buildings at all but four of the reconstruction hospitals had not yet been approved; admitted that the plans for new construction at those and other hospitals would have to be replaced by plans for utilizing existing buildings, and possibly the shops of existing industrial concerns where large cities were in the vicinity; stated that a disabled soldier should have as complete functional and physical restoration as possible in the military hospital in order to be a fit subject for training by the Federal Board for Vocational Training.

Furthermore, the following modification of the plan published on August 1, 1918, for fulfilling the obligations of the Medical Department to disabled soldiers, was recommended: (1) That general physical reconstruction be applied in the hospitals named: Walter Reed General Hospital, Takoma Park, D. C.; General Hospitals No. 2, Fort McHenry, Md.; No. 3, Colonia, N. J.; No. 6, Fort McPherson, Ga.; No. 9, Lakewood, N. J.; No. 10, Boston, Mass.; No. 11, Cape May, N. J.; No. 26, Fort Des Moines, Iowa; No. 27, Fort Douglas, Utah; No. 28, Fort Sheridan, Ill.; No. 29, Fort Snelling, Minn.; No. 30, Plattsburg Barracks, N. Y.; No. 31, Carlisle, Pa.; base hospital, Fort Sam Houston, Tex. That reconstruction for the blind be carried on at General Hospital No. 7, Roland Park, Md. That modified facilities for curative work be applied in the treatment of tuberculosis at General Hospitals No. 8, Otisville, N. Y.; No. 16, New Haven, Conn.; No. 19, Azalea, Oteen, N. C.; No. 20, Whipple Barracks, Ariz.; No. 21, Denver, Colo.; Fort Bayard, N. Mex. (2) That necessary alterations be made in existing buildings to provide for the curative workshop schedule and physical treatment at the hospitals named, and that a simple curative workshop equipment, value \$3,000, be installed at those hospitals not already supplied. (3) That \$1,000 be allowed each hospital for material to be used in carrying out the curative workshop schedule. (4) That authority be given to transfer from other hospitals to reconstruction hospitals patients requiring reconstruction treatment. The necessity was emphasized of accepting and enforcing the principle that, as soon as the disabled soldier should have reached the stage of as complete physical and functional recovery as was possible, when the nature of his disability was considered and he was convalescent, he should be transferred to the convalescent detachment in the camp or directly discharged from hospital. (5) That personnel to carry out efficiently the curative workshop schedule should be maintained, either by transferring suitable officers and enlisted men to the Medical Department from other branches of the service or by granting authority for further commissions and promotions in the Medical Department. (6) That \$1,000 be granted to each of the 18 base hospitals named below to purchase expendable material necessary to apply a moderate amount of curative work, a sufficient equipment being already available: Camp Gordon, Ga., Camp Jackson, S. C., Camp Lee, Va., Camp Meade, Md., Camp Sherman, Ohio, Camp Taylor, Ky.,

Camp Funston, Kans., Fort Riley, Kans., Camp Pike, Ark., Camp Travis, Tex., Camp Custer, Mich., Camp Grant, Ill., Camp Dodge, Iowa, Camp Lewis, Wash., Camp Dix, N. J., Camp Devens, Mass., Camp Upton, L. I., N. Y., Camp Kearny, Calif. (7) That convalescent soldiers, disabled by sickness or injury while in the United States, as well as those disabled overseas, be sent to convalescent centers, and that barracks be provided at those centers for quarters, mess, and training purposes, located near the various welfare centers conducted by the Young Men's Christian Association, American Red Cross, etc. (8) That sufficient personnel and equipment be provided at those centers to obtain the maximum restoration of convalescent soldiers by intensive treatment and training. As this treatment and training was chiefly a medical problem, that a medical staff for each center be supplied, consisting of a chief surgeon with the rank of major, a general surgeon, a heart specialist, an orthopedist, a mental specialist, a specialist in diseases of the lungs, and two general medical officers; consultants in surgery and medicine should visit the camp in an advisory capacity. Overexercise or absence from training interfering seriously with the rapid recovery of a convalescent, the chief surgeon must prescribe the amount of physical training, exercise, and mental work to be performed, and control the issuing of passes and the assignment to fatigue duty. (9) That camp commanders detail at once the necessary line officers and enlisted men to form the permanent cadre at these centers to provide administration, supply, and mess as there was need for their immediate organization. The importance of the work to be performed in these detachments of overseas convalescents should be borne in mind and competent line and medical officers chosen for the duty. They should be impressed with the fact that cooperation was necessary in order that the best results might be obtained; that the final object sought was the earliest possible return of these men to civil life, restored to the best possible physical and mental condition.

The Secretary of War approved this modified plan of reconstruction substantially as outlined, but it was directed that the transfers of personnel would be proposed by name in each case, the individuals to be selected by the Surgeon General from those who desired the transfer.²⁶

SECTION OF EDUCATION

During the process of reorganization given above the educational aspect of the reconstruction problem was less emphasized than were the other branches of the activity. The dean of Teachers' College, Columbia University, New York City, who was appointed director of the educational section in April, 1918,²⁷ submitted an outline of the proposed policy of the section on May 29, 1918, which covered the general principles and organization of the section, and another on July 15, 1918, stating the policy as applied to the patients to be served. As these two documents comprise the first outlines of work proposed, they are reproduced here in their entirety:

MAY 29, 1918.

Memorandum for Colonel Billings, M. C., N. A.

Subject: Policy of department of education in division of physical reconstruction.

AIM

The aim is to promote the physical and functional rehabilitation of disabled soldiers and sailors by means of purposive play, work, and study.

NEED OF EDUCATION

It is conceded that the physical rehabilitation of disabled men is peculiarly dependent upon their mental attitude. The more serious the disability, the greater the danger of mental depression and an indisposition to respond to medical and surgical treatment. The educational work should begin, therefore, at the moment when the man has arrived at the stage where he begins to worry about his future. The first problem is to divert his attention, by simple recreation through reading, pictures, games, handiwork occupations, and the like, with a view to securing a genuine interest in the attainment of some worthy end. The end most certain to hold his attention and to claim his best efforts is his future vocation. Hence, by gradual steps, he may be induced to supplement his previous vocational experience by academic, scientific, or technical instruction, or to choose a new vocation and begin preparation for it if such a course is necessary.

It is understood that whatever recreational, general, or technical training is given to a hospital patient is to be administered in "doses" as prescribed by the medical authorities and as a therapeutic measure.

SCOPE OF WORK

The need of "cheer-up" work in the hospitals extends to all who are mentally capable of planning for their own future. This means a relatively large proportion of the entire number. If the educational staff does its full duty it should reach and interest in some way and to a marked degree a full half of all the men who remain under hospital treatment for a considerable period. A properly conducted school of secondary or higher grade provides one teacher for 10 pupils. Disabled men need even more individual attention than school pupils. Hence provision should be made in each reconstruction hospital for at least one teacher for every 10 men.

Ample provision will be made by Congress for the vocational training of disabled men after their disability. Millions of dollars will be expended and the resources of the entire country will be drawn upon for this purpose. The success of the national program for vocational training will depend almost entirely upon the preparation made for it in the hospital. A moral obligation, therefore, rests upon the War Department to see that every possible consideration is given to the man in need of vocational guidance and educational reconstruction.

Much depends upon the personality of those who lead in this work. It should not be done in a mechanical fashion, and mechanically-minded men can not succeed in it. The choicest spirits in the teaching profession must be attracted to it, and in this time of national need such men will respond as a patriotic duty. The one thing needful is the moral, official, and financial backing of the War Department.

PLANS OF ADMINISTRATION

a. In the Surgeon General's Office:

1. A head of the department of education, ranking as a lieutenant colonel, responsible to the chief of the division of physical reconstruction.
2. Subordinate to the head of the department of education, four inspectors with the rank of major. The duties of these inspectors to be divided according to the division of function in the hospitals hereinafter mentioned.
3. Officers of lower grade, secretaries, and clerks as needed.

b. In the hospitals:

1. A director of educational service, ranking with the directors of medical and surgical service, subordinate to the commanding officer.
2. Four heads of departments, to wit: (a) Recreational, (b) psychological and statistical, (c) academic, (d) technical, subordinate to the director of educational service.
3. Teachers, assistants, secretaries, and clerks as needed. Many of these will later be drawn from the list of competent men who have been disabled in service.

FUNCTION OF DEPARTMENTS

1. Recreational department: To provide diversion by entertainment with music, pictures, books, lectures, and exhibitions; to give amusement in games and sports; to direct handiwork occupations in the fine and industrial arts; and to cooperate with other agencies, such as Young Men's Christian Association, Red Cross, and the like.

2. Psychological and statistical department: To be responsible for all records that may be deemed necessary for the joint use of the educational departments and the authorities which may subsequently have control of vocational training and placement; to act as consultant on all psychological problems and to make studies of procedure and methods as requested by the directors of the medical and educational services.

3. Academic department: To provide elementary instruction for illiterates; conduct classes for those who may profit from secondary and higher courses; arrange for correspondence courses and individual instruction of men who wish to return to college and assist in guiding competent men to professional training in the learned professions.

4. Technical department: To provide instruction in prevocational subjects, such as drawing, design, trade mathematics, applied science; to direct curative workshops; and to give such vocational training as may be found necessary and expedient in the case of individuals who can profit from such specialization in industrial, commercial, and agricultural work.

METHODS

Individual instruction, class work, and group teaching in wards, classrooms, and curative shops. The scarcity of supply of competent teachers in many lines essential to success in this work will necessitate the establishment of training classes in hospitals and making arrangements with existing institutions to train disabled men who may be detailed for the purpose.

EMERGENCY NEEDS

Until men who have been overseas can be selected and trained for teaching it may be necessary, expedient, and economical to employ civilians as teachers and assistants for definite periods of service. Frequently special teachers will be needed for emergency service and equipment will be called for outside the regular supply. The welfare of patients will be seriously jeopardized unless the necessary teachers and supplies can be secured promptly. It is highly important, therefore, that an emergency fund be provided which may be drawn upon by the department as need arises for the purchase of supplies and the payment of salaries to civilians.

STATEMENT OF POLICY

JULY 15, 1918.

Memorandum for Colonel Billings:

Subject: The educational policy of the division of physical reconstruction.

1. Hospital patients, from the military standpoint, are of three general classes: A, Those who can be restored to full duty; B, those who can be fitted for limited service; and C, those disabled to the extent of unfitting them for further military service.

Of the 1,600 patients that have passed through Fort McHenry Hospital only 65 were recommended for immediate discharge as being of no further service to the Army. It is estimated that 25 per cent belong to class A above, 65 per cent to class B, and 10 per cent to class C. The commanding officer at Fort McHenry states that he has just released 30 able-bodied men for overseas duty and has filled their places with patients. He expects to replace all his hospital corps with returned soldiers.

2. Patients of the first class (A) should have, when circumstances warrant it, the benefit of the therapeutic treatment through play, work, and study, as may be prescribed by medical officers, in order that their morale may be stiffened, their special skills improved, their future usefulness increased, and their recovery hastened.

3. Patients of the second class (B) should have, whenever conditions permit and the medical officers approve, such specific training—physical and vocational—as will, in the judgment of the educational officers, best fit such patients for limited service of a particular kind. At present patients are being trained in general hospitals for limited service as general

and vocational teachers, typists, printers, tailors, cobblers, harness makers, welders, motor mechanics, painters, machine workers, woodworkers, bookkeepers, statisticians, telegraphers, photographers, telephone operators, cooks, storekeepers, electricians, etc.

The list can be extended with the advice and cooperation of the committee on education and special service of the War Department to meet other needs as they arise. In connection with the large general hospitals there is abundant opportunity for practice in many trades and occupations. At Fort McPherson, for example, practical experience can be gained in 20 different trades. Moreover, there is immediately adjacent to the hospital a larger quartermaster's mechanical repair shop covering all phases of mechanical repair and units to which men can be assigned for limited service or to gain experience.

4. Patients of the third class (C) should be encouraged in every possible way to accept the benefits accorded to them for vocational training by the Federal Board for Vocational Education. To this end they should have, while in the hospital, such physical training and general education as will best promote their physical reconstruction and at the same time contribute most to their vocational training. Patients who do not elect, or who are not eligible, to continue their education under the Federal board should receive such training as the medical and educational officers deem best in each individual case.

5. To carry out this program calls for an exceptionally able personnel. It is expected that within a few months enough teachers can be secured, either by the induction of specialists or by restoration to limited service of partially disabled men, but such men must be trained to teach and their work must be carefully supervised. The experience of Canada shows that one teacher is required for every 10 men under training. The supervisory and directing staff, composed of commissioned officers and civilians, must be large enough and capable enough to make the work effective. Each hospital should have sufficient equipment for its ordinary educational needs and an emergency fund for the procurement of supplies that can not be anticipated and for the employment of civilian instructors when the regular staff is inadequate.

JAMES E. RUSSELL,

Director of Department of Education, Division of Physical Reconstruction.

The activities of the division of physical reconstruction during the summer and fall of 1918 largely concerned the educational section, as the organization of the physiotherapeutical work was so well advanced that it required only occasional statements to the hospitals of the policy concerning individual matters. The educational section became the educational department in September, 1918, and was divided into the (1) office section, (2) field section, (3) psychology section, and (4) publicity section.²⁸ The dean of the University of Minnesota became the civilian director of the department on October 1, 1918.²⁹

Authority was obtained late in September to employ four especially qualified aides in the department office as supervisors of occupational aides to meet the administrative demands of the increasing personnel of that class.³⁰

The pendulum of enthusiasm for vocational work swung so far in the fall of 1918 that curative work and play were being neglected, particularly as applied to the amputation cases, and these features were considered to constitute one, if not the greatest, advance in the care of the amputated.³¹ It was the consensus of opinion of the medical officers engaged in their care in one general hospital that no effective effort was being made in this direction, and it was recommended that a corps of persons trained in the particular features of curative work and play for the amputated be organized.³¹

UNIT COURSES OF STUDY

There were several factors in educating disabled soldiers which did not enter into normal teaching experience. These were the varied mental capacities and the mental states of the students, the relatively short time available,

and the varied abilities and personal characteristics of the available teaching personnel. In addition, it was necessary to coordinate the work in hospitals with the vocational work which the students would later take under the Federal Board for Vocational Education.

To assist the educational staffs of the hospitals in so organizing their work as to meet these conditions "unit courses of study" were drawn up by a joint committee of representatives from the educational department in the Surgeon General's Office and from the Federal Board for Vocational Education and published in pamphlet form. Each pamphlet consisted of an outline of a short, complete course in one particular phase of a subject, requiring only a comparatively few study hours for completion. Study sheets giving the details of the course necessarily were prepared by the instructors, who also could prepare unit courses of their own for branches of the subjects not covered by the published courses, as the committee had laid down definite specifications covering all courses, but had actually drawn up only a few in each subject. The pamphlets were published during the period from November, 1918, to February, 1919.^a

PREPARATION FOR OVERSEAS CASES

During the early months of 1919 the attention of the division of reconstruction was concentrated largely on the problem of the preparation for and reception of the overseas disabled. The fundamentals of the problem having been solved by the approval of the modified program for reconstruction, there remained to be accomplished only the provision and equipment of a sufficient number of reconstruction hospitals to accommodate the patients to be received. There were barely sufficient beds available for the purpose at the first of the year, provided no epidemics or other unexpected occurrence made unusual demands on the hospitals; however, the danger of the narrow margin in the number of reserve beds was decreased considerably by the establishment of the convalescent centers.^{32 b}

At this time there was an anxiety to be discharged among both officer and enlisted patients that amounted almost to hysteria and was universal, leading to a great difficulty in retaining in the service sufficiently long to effect maximum restoration of function any man who was not confined to bed. Everyone seemed to have an almost uncontrollable desire to get out of the service and to go home and do nothing but rest for several months. Patients would make all manner of optimistic statements as to their conditions, obtain guarantees from relatives and friends for necessary treatment after discharge, and in many other ways influence medical officers, against their better judgment, to recommend discharges. To relieve the pressure brought to bear by relatives and friends of homesick disabled soldiers, and because these patients would not respond to the fullest extent to treatment in a military hospital while in this frame of mind, the War Department gave authority on December 31, 1918, to discharge such men, on their own application, who furnished documents from relatives or friends which guaranteed the necessary specialist treatment after discharge, and released the War Department from further responsibility for their treatment.³³

^a These pamphlets are reproduced in the appendix to this volume.—*Ed.*

^b This subject is discussed more fully in succeeding pages under the heading "Convalescent centers."—*Ed.*

This provision for discharge caused great anxiety among those responsible for the fulfillment of the reconstruction program, the fear being expressed that the majority of the disabled would return to civil life in a physically unfit condition rather than in the best condition possible, as planned, thereby completely destroying the general utility of the entire reconstruction program and ultimately leading to a pension system through political pressure.³⁴ These fears were not realized; on the contrary, the hospitals were relieved of a large group of dissatisfied patients, and this factor, together with the legitimate discharge of men with the slighter degrees of disability, soon resulted in a great lessening of the burden of the Medical Department so far as available beds were concerned. The peak of the load occurred in March, 1919.³⁵

Toward the latter part of May, 1919, 18 general hospitals and 2 base hospitals, in addition to the 3 general hospitals for tuberculous cases, remained as reconstruction hospitals, with an approximate bed capacity of 28,000, and plans were made to close certain hospitals as the need for them declined;³⁶ the reception of overseas cases at the hospitals of demobilization camps had already been stopped, and it was the intention to have no activity in these hospitals, except from local sources, by July 1, 1919.

Nine of these 20 hospitals were designated to function longest, as follows:³⁶ Army and Navy General Hospital, Hot Springs, Ark.; Letterman General Hospital, San Francisco, Calif.; Walter Reed General Hospital, Takoma Park, D. C.; General Hospital No. 6, Fort McPherson, Ga.; General Hospital No. 19, Oteen, N. C.; General Hospital No. 21, Denver, Colo.; General Hospital No. 26, Fort Des Moines, Iowa; General Hospital No. 31, Carlisle, Pa.; and Department Base Hospital, Fort Sam Houston, Tex.

The following additional 11 hospitals were named as those which would operate long enough after July 31, 1919, to receive and care for the 8,000 more or less chronic cases which were then in general hospitals without later transfer:³⁶ General Hospital, Fort Bayard, N. Mex.; General Hospital No. 2, Fort McHenry, Md.; General Hospital No. 3, Colonia, N. J.; General Hospital No. 8, Otisville, N. Y.; General Hospital No. 20, Whipple Barracks, Ariz.; General Hospital No. 28, Fort Sheridan, Ill.; General Hospital No. 30, Plattsburg, N. Y.; General Hospital No. 41, Fox Hills, Staten Island, N. Y.; General Hospital No. 42, Spartanburg, S. C.; General Hospital No. 43, Hampton, Va.; and Base Hospital, Fort Riley, Kans.

In order that the hospitals named could furnish the required bed capacity, it was directed that the ordinary distribution of patients from ports to the hospitals nearest their homes would be disregarded to the extent that the patients would be sent to the hospitals nearest their homes where beds were available.

DIVISION OF PHYSICAL RECONSTRUCTION ABOLISHED

The activities of the Surgeon General's Office had so diminished by June 20, 1919, that the division of physical reconstruction was discontinued, becoming the section of physical reconstruction in the division of hospitals.³⁷

STABILIZING PHYSICAL RECONSTRUCTION

The number of patients in hospital declined steadily throughout the latter half of the year 1919, which allowed the closing of reconstruction hospitals from time to time and the coincident discharge of personnel.³⁸

No further questions of policy of any great magnitude arose in the reconstruction section during the year 1919; such questions as did arise will be covered in succeeding chapters. The reconstruction cases remaining in hospital by the latter part of 1919 were necessarily of a chronic nature, the majority having undergone several surgical operations. Since many of them desired discharge at once and their treatment in a military hospital held no particular advantages over treatment in any other first-class hospital, and as the War Risk Insurance Bureau had made provision for their hospital care after discharge, the War Department announced the following policy concerning those chronic cases, on November 7, 1919: ³⁹ (1) That all disabled military personnel, except officers of the permanent Army and special surgical cases, should be granted discharge six months after admission to a hospital in the United States for definitive treatment if discharge was desired and applied for by the individual in writing. (2) That all patients of the same classes, with the additional exception of mental cases, should be discharged after one year in hospital. If too sick to be moved or unable to provide the necessary care for themselves, they were to be retained until provision was made for them by the War Risk Insurance Bureau, Soldier's Home, or the National Home for Disabled Volunteer Soldiers.

No supporting documents guaranteeing further treatment after discharge or relieving the War Department from further responsibility for treatment were required.

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- (3) Memorandum from Lieut. Col. T. C. Lyster, M. C., to the Surgeon General, August 15, 1917. Subject: Reconstruction, reeducation and after-care of disabled soldiers. On file, Record Room, S. G. O.
- (4) Memorandum, Surgeon General's Office, August 22, 1917. Subject: Division of special hospitals and physical reconstruction. Also attached papers. On file, Record Room, S. G. O., 115568-11.
- (5) Memorandum on the administrative reorganization of the reconstruction division, Surgeon General's Office, undated and unsigned. On file, Historical Division, S. G. O.
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- (7) Annual Report of the Surgeon General, United States Army, 1918, 396.
- (8) Letter from the chief, division of orthopedic surgery, to the Surgeon General, November 3, 1917, and attached papers. Subject: Weekly report. On file, Historical Division, S. G. O.
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- (17) Office order, Surgeon General's Office, May 13, 1918, unnumbered. On file, Record Room, S. G. O., 024.
- (18) Memorandum from Col. Frank Billings, M. C., for all officers of the division of reconstruction, Surgeon General's Office, May 31, 1918. On file, Historical Division, S. G. O.
- (19) Memorandum from the Surgeon General to the Secretary of War, November 7, 1917. Subject: Plan for physical reconstruction and vocational training. Also attached papers. On file, Record Room, S. G. O., 356 (Reconstruction).
- (20) Fifth indorsement from The Adjutant General to the Surgeon General, May 6, 1918. On file, Record Room, S. G. O., 356 (Reconstruction).
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- (22) Office Order No. 36, Surgeon General's Office, May 13, 1918. On file, Record Room, S. G. O., 024.7.
- (23) Report on the physical reconstruction of invalided and disabled soldiers, from the division of physical reconstruction, Surgeon General's Office, June 3, 1919. On file, Record Room, S. G. O., Miscellaneous Letters, A-961.
- (24) Letter from the Surgeon General to the Chief of Staff, June 25, 1918. Subject: Physical reconstruction. Also attached papers. On file, Record Room, S. G. O., 353.91-1.
- (25) *Official Bulletin*, August 1, 1918. (Published daily by the Committee on Public Information, George Creel, chairman, Washington, D. C., 1918.) On file, Record Room, S. G. O.
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- (31) Memorandum from Lieut. Col. David Silver, M. C., to Colonel Richardson, M. C., October 2, 1918. Subject: Curative work for the amputated. On file, Historical Division, S. G. O.
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- (34) Letter from Third Assistant Secretary of War to Dean Russell, January 9, 1919, and attached papers. On file, Record Room, S. G. O., 353.91-1.
- (35) Weekly bed reports, hospital division, Surgeon General's Office.
- (36) Memorandum from the Surgeon General from the division of reconstruction, May 24, 1919. Subject: Conclusion arrived at with reference to hospitalization. On file, Historical Division, S. G. O.
- (37) Annual Report of the Surgeon General, United States Army, 1919, Vol. II, 1180.
- (38) Annual Report of the Surgeon General, United States Army, 1920, 268, 282, 283.
- (39) Memorandum from the Chief of Staff to the Surgeon General, November 7, 1919. Subject: Policy re protracted hospital treatment for military personnel. On file, Record Room, S. G. O., 705-1.

CHAPTER II

PERSONNEL

COMMISSIONED AND ENLISTED

The plan for reconstruction of the disabled men of the Army, approved by the War Department on July 31, 1918, embraced authority to commission in the Sanitary Corps of the Medical Department the necessary personnel of educational officers to administer the work in the Office of the Surgeon General and in each of the hospitals designated for reconstruction.¹

On July 31, 1918, the Surgeon General designated the following general hospitals to function in physical reconstruction:² Walter Reed, Washington, D. C.; Letterman, San Francisco, Calif.; Fort Bayard, N. Mex.; No. 2, Fort McHenry, Md.; No. 3, Colonia (Rahway), N. J.; No. 6, Fort McPherson, Ga.; No. 7, Baltimore, Md.; No. 8, Otisville, N. Y.; No. 9, Lakewood, N. J.; No. 10, Boston, Mass.; No. 11, Cape May, N. J.; No. 12, Biltmore, N. C.; No. 20, Whipple Barracks, Ariz.; No. 21, Denver, Colo.; No. 24, Parkview, Pa.; No. 26, Fort Des Moines, Iowa; No. 28, Fort Sheridan, Ill.; No. 29, Fort Snelling, Minn.; No. 30, Plattsburg Barracks, N. Y.; No. 31, Carlisle, Pa.; No. 36, Detroit, Mich.; No. 38, Eastview, N. Y.; No. 41, Fox Hills, Staten Island, N. Y.; No. 42, Spartanburg, S. C.; No. 43, Hampton, Va.

The personnel of each of the hospitals designated comprised:

1. An educational personnel consisting of—

(a) Chief educational officer, with assistants in technical and agricultural training and psychologists.

(b) Instructors in academic, commercial, trade, and agricultural occupations.

(c) Civilian women (reconstruction aides) qualified by previous experience as teachers and by intensive training to teach the sick and wounded in the arts and handicrafts and in academic and commercial studies in the wards.

2. A director and qualified personnel of enlisted men to apply to various types of physiotherapy, assisted by—

(a) Civilian women employees (reconstruction aides) qualified by education, experience, and intensive training to apply massage, thermo-, electro-, and local hydro-therapy.

3. A director of recreation in sports, games, gymnastics, and military drill, with a qualified personnel of assistants, in cooperation with the Commission on Training Camp Activities of the War Department, the American Red Cross, the Young Men's Christian Association, the Knights of Columbus, the Jewish Welfare Board, and the Salvation Army.

During the period preceding the armistice personnel for reconstruction service in Army hospitals was obtained by the selection and induction from civil life of specially qualified educators who, by reason of physical disabilities, were eligible only for limited service or were men over draft age. A careful canvass was made of the educators of the United States through correspondence with universities, colleges of education, and technical schools. From names so obtained an eligible list was made and a few men were commissioned prior to the beginning of the armistice.³ At the time the armistice was signed commissions were pending for a large number of such specially qualified men who

had not been inducted previously.³ In so far as the educational department was concerned, there was no need for a great number of educators prior to the time in question, since wounded men had not been returned in any great number to the United States from the American Expeditionary Forces. With the signing of the armistice, however, there came a stoppage of new commissioning and of promotions,⁴ and thus all pending commissions in the entire list of available qualified candidates for the educational services automatically were wiped out. In the department of physiotherapy the personnel of administrative offices was obtained from the Medical Reserve Corps. In both the educational and physiotherapeutic departments an enlisted personnel was assigned.

Following the signing of the armistice the work of the reconstruction service properly began, since plans now were effected to return the wounded from France without undue delay. This rapid return of the wounded from overseas, however, made necessary an emergency expansion of the reconstruction service, when, as a matter of fact, the stoppage of new commissions referred to above actually made a relative shortage of personnel. Therefore it was necessary to secure from other Army organizations men who would be even fairly qualified for this service.³ Medical Department men were assigned from hospital detachments. Many of these men had had neither previous experience, training, nor aptitude for the work of instruction. Commissioned officers were sought and secured by transfer from the psychological division of the Medical Department, from the Infantry, the Engineer Corps, and the Signal Corps. Though this method of expanding the personnel inevitably resulted in many disappointments, it nevertheless brought to the educational service at a time of greatest stress and need some of its best qualified and most efficient instructors. Instructions were sent from the Office of the Surgeon General to all camps and organizations to initiate requests on commanding officers to make a search for all men who might be qualified to act as instructors and at the same time be willing to undertake such service.⁵ Other efforts along the same line were made. Commanding officers of base hospitals frequently were able to secure instructors by causing a canvass of camp personnel to be made. To obtain desired instructors in this way necessitated that the men be in the Army, that they be willing to remain, that they manifest a desire to enter the educational service, and that they have some aptitude and qualifications indicative of the fact that they might be successful teachers. Furthermore, it was essential that their respective commanding officers signify a willingness for this release.

In the spring of 1919, though the demand for beds in the reconstruction hospitals was slowly decreasing, the personnel of the Medical Department was being discharged at a faster rate than the decrease in demand for beds in reconstruction hospitals would seem to warrant, so that the individual burden was increasing. Therefore it became necessary to establish a policy which would provide not only for the demobilization of Medical Department personnel in the reconstruction service but also for the continued treatment of the patients, as the necessity for their care would continue long after general demobilization was completed.

As the Medical Department enlisted men were making insistent demands for discharge, the Surgeon General recommended, on April 22, 1919, that, for purposes of reconstruction, the enlisted personnel of the Medical Department be not replaced by civilian employees, as the work devolving upon them in the demobilization of troops and the care of sick and wounded demanded an organization both well trained and disciplined.⁶ He also believed that it would not be advisable to discharge some of them and then reemploy them as civilians, because of the dissatisfaction that would result among those not so favored; and, further, that the manning of hospitals by civilians would make the maintenance of discipline difficult and might decidedly impair the operation of the hospitals, as they could not be held to the obligation which must be fulfilled in the treatment of sick and wounded.

Later, the Surgeon General considered it necessary to change this policy, owing to the great demand for discharge, and he recommended to the War Department, in order to promote voluntary consent to remain in service for the duration of the emergency:⁷ That two or three sergeants, first class, of the educational and physiotherapy enlisted personnel of each hospital be promoted to the grade of second lieutenant, Sanitary Corps; that the educational enlisted personnel of each hospital be informed that that service would be acutely needed during the emergency; that the men who desired to make engagements as teachers in civilian institutions or to make arrangements for a continuation of their studies in schools and colleges might do so, with the understanding that these men would be released from service on or before the opening of the fall term of the next school year; that men who desired to take advantage of the opportunity for discharge should make an early written request to the Surgeon General for release on or before the date mentioned; that additional qualified civilian instructors be employed at \$100 to \$250 per month to make the necessary replacement of the enlisted men who would be released for special reasons before the emergency need ceased.

No action on his communication having been taken, the Surgeon General modified his recommendation on July 14, 1919.⁷ He now advised the discharge of all enlisted men who desired discharge, and their replacement with reconstruction aides as teachers, and civilian employees as instructors in shop work, in the belief that one individual who was voluntarily in the service was more efficient than three who were anxious to be discharged and were retained against their wills.

On July 19, 1919, the War Department called upon the Surgeon General for an estimate of the number and cost of the civilian employees suggested; expressed the opinion that the salaries quoted were too high; disapproved the proposed promotion of noncommissioned officers to commissioned grade.⁷ The desired information was furnished from the Surgeon General's Office on August 9, with the comment that the character of the work was such that it could satisfactorily be performed only by individuals of higher intelligence and earning capacity.⁷ It had been estimated that 75 teachers of experience would be needed with salaries ranging from \$125 to \$175 per month, and 50 trades instructors at salaries from \$175 to \$200 per month.

Educational and vocational training had been extended in July to those of the entire enlisted personnel of the Army who desired to avail themselves of the opportunity, and this further interfered with the execution of reconstruction duties by the personnel of the hospitals.⁸

In lieu of the employment of civilians, it was determined to concentrate on the assignment of enlisted men to function in the care of sick and disabled, abandoning all efforts to organize and train divisional and other units. With the operation of this policy and the later increase in enlistments by the adoption of one-year periods of service, it became possible by December, 1919, to accomplish the separation of all temporary enlisted men who desired discharge.⁹

The question of a sufficient number of commissioned officers properly to care for the patients in reconstruction hospitals caused even more difficulty at the time in question. Congressional appropriations for the fiscal year ending June 30, 1920, limited the number of officers holding emergency commissions which could be retained in the service. This resulted in an order by the War Department in July, 1919, for the discharge of all such officers by September 30, 1919.¹⁰ Since this would seriously handicap the work of the Medical Department, the Surgeon General requested that the Medical Department be allowed to retain in the service 2,000 officers holding commissions for the emergency only.¹¹ This request was made on the grounds that 619 officers were necessary to fill the existing vacancies in the regular Medical Corps and care for the normal sick of the authorized enlisted force of the Army, and 1,400 were required for the care of the 24,000 additional patients remaining from the war. Fortunately, the order for the discharge of temporary officers was rescinded by the Secretary of War in September, 1919, and the retention of a sufficient number in the Medical Department was authorized.¹²

CIVILIAN PERSONNEL

PHYSIOTHERAPY AIDES

The original organization of the division of special hospitals and physical reconstruction included a section of physiotherapy.¹³ It was soon evident that this branch of therapy was too broad and too technical to be performed satisfactorily by enlisted personnel of the Medical Department alone, and investigation indicated that there were relatively few persons in this country with the requisite training to undertake the varied work which would be demanded in our military hospitals. Accordingly it was proposed in September, 1917, to open a training school for medical aides in the general hospital to be established at the United States Soldiers' Home, Washington, D. C., the students to consist of two classes—enlisted men and civilians, the latter to be almost entirely women.¹³ Those who already were trained in the procedures required were to be given a course of instruction in the peculiar character of the work to be performed; the others were to receive a complete course of training to fit them for this work. Soon after this a woman was appointed as supervisor of aides.¹⁴ A consideration of the educational aspect of reconstruction indicated that some of the educational phases would be so closely related to the physiotherapeutic that it might be advisable to place the control of the medical aides under this section of the project, but such action was not taken.¹⁴

The medical officer who was appointed as chief of the section of physiotherapy, November 15, 1917, proceeded to organize the section to meet the prospective demands by a selection of personnel, as well as the standardization of apparatus and the drawing of plans for special-treatment buildings.¹⁴ The succeeding months were devoted to a study of the work to be accomplished. It was decided that the work in and for the hospital wards could best be performed by women in most instances, and a section of the civilian personnel employed by the Medical Department was accordingly planned, to be known as "The Women's Auxiliary Medical Aides."¹³ A circular had been published December 31, 1917, by the Surgeon General's Office stating that the object was to meet the need for a large number of persons properly trained to carry out the work of special massage and remedial exercises in the hospitals or other sanitary formations of the Army, especially in the orthopedic care of patients, and placing the aides under the direction of the division of military orthopedic surgery. This circular also provided for the pay and allowances of the aides; for a supervisor, defining her duties; for a chief aide where more than one aide was on duty; for a qualification standard and a uniform; and for a reserve to be called in time of emergency. The name for the class of employees referred to was soon after changed to "reconstruction aides," and this term included those engaged in education also.

The aides were obtained for the Medical Department by a canvas of institutions which trained teachers, and of other schools, and by general notices in the newspapers. Each candidate submitted a detailed statement of her experience and qualifications with her application for appointment.¹⁴ These were scrutinized carefully and inquiry was made of persons who were most likely to have known of her fitness for the work. Qualification in a physical examination insured the physical strength necessary for the work to be performed. The selections were made from a review of the accumulated information, often supplemented by an interview with the individual. In assigning the selected individuals to hospitals the aim was to appoint to each hospital a team of instructors, all familiar with elementary crafts, the general information and purposes of the reconstruction program, and each a specialist in an important line. The type of woman sought was one qualified and experienced as a teacher of adolescents or adults in high school, normal school, or college, and also possessed of knowledge of the crafts. The ability to associate with young men on a friendly footing without encouraging undue familiarity was a very necessary part of the qualification as a teacher.

OCCUPATIONAL AIDES

All studies of reconstruction as practiced by our allies indicated the necessity of early ward occupation for convalescents, in order to prevent hospitalization, in its pre-war sense, by consuming as much of their time as possible. This light work was to reawaken their mental activities, arouse their ambitions, relax stiffened joints and contracted muscles, and prove to them that their usefulness was not at an end but depended upon their own exertions. So the official specifications for this work, as approved by the Surgeon General, January 5, 1918, were:¹⁵

1. Purely medical function.
2. For the therapeutic benefit of activity—

- (a) To be prescribed in the early stages of convalescence;
- (b) To occupy;
- (c) To prevent hospitalization;
- (d) To prepare the mind for subsequent occupational (vocational) treatment;
- (e) Not to be in any sense vocational; and
- (f) The work to be simple, quickly done, and have commercial value.

Suitable work for men weakened by illness and injury consisted of activities which were along educational lines, such as beadwork, weaving of various kinds, academic studies, games, and drawing. Therefore, the aides engaged in that work were known as "occupational aides" and were under the immediate direction of the educational service,¹⁵ in contradistinction to the physiotherapy aides, who were under medical direction.

To supplement the limited number of persons who were qualified to conduct occupational work it was proposed in January, 1918, to introduce special courses in a number of established schools to train 1,000 women for this service by October 1, 1918.¹⁵ Such courses were established in March and April, 1918.

A call for women to serve as reconstruction aides in occupational therapy was issued by the Surgeon General's Office August 8, 1918.¹⁶ It was felt at the time that 1,000 such women would be needed for overseas service within a few months and others in hospitals in the United States to teach handicrafts and other subjects. The requirements for such service and the pay, allowances, etc., were given.

The classification of occupational therapy aides gives an idea of the scope of the proposed occupational work:¹⁶ Class A, expert in one or more lines—social worker, library service; teacher in industrial and fine arts, general science, English, commercial branches, free-hand drawing and design, mechanical drawing, telegraphy and signalling, French, manual training, agriculture (gardening and floriculture), music, plays, and games, mathematics. Class B, as teacher or craftsman in one or more lines—knitting (hand, machine, rake), weaving, clay and papier-mâché modeling, wood carving and toy making, metal working, jewelry, and engraving. Class C, informed on all lines—military procedure in hospitals, War Department's program for physical reconstruction of disabled soldiers, regulations as to insurance, pensions, etc., under the War Risk Insurance Bureau, and opportunities offered by the Federal Board for Vocational Training.

Official consideration of the status, pay, and allowances of reconstruction aides led to the opinion that they should be placed on an approximate equality with nurses for pay and allowances.¹⁷ Official and unofficial discussion as to a desirable status emanated from the personnel for many months. Meanwhile, representatives from the Surgeon General's Office unofficially but with the approval of the Surgeon General had been slowly developing a rudimentary reconstruction service at Walter Reed General Hospital, Washington, D. C. (initiated in February, 1918),¹⁸ and a like process was taking place at General Hospital No. 2, Fort McHenry, Baltimore, Md.; General Hospital No. 3, Colonia, N. J.; General Hospital No. 6, Fort McPherson, Ga.; and General Hospital No. 9, Lakewood, N. J. This early work was of extreme value as a proved basis on which to construct maturer plans. The first reconstruction

aides to be appointed were sent to Walter Reed Hospital in late February and early March of 1918. These were all occupational aides, although the earliest plans for training considered physiotherapy aides alone.

TRAINING SCHOOLS FOR AIDES

Certain schools in this country made provision for the establishment of preliminary training courses for those who wished to qualify as reconstruction aides, and were only awaiting the final determination of policy in the Surgeon General's Office before opening the courses. Early in the year 1918 the Surgeon General approved the outlines of courses submitted by these schools, and the following schools were conducting such courses in April:¹⁹ In physiotherapy: ^a American School of Physical Education, Boston, Mass.; Boston School of Physical Education, Boston, Mass.; Prose Normal School of Gymnastics, Boston, Mass.; New Haven Normal School of Gymnastics, New Haven, Conn.; Normal School of Physical Education, Battle Creek, Mich.; Reed College, Portland, Oreg.; Teachers' College, Columbia University, New York City. In occupational therapy: ^b Teachers' College, Columbia University, New York City. The curriculum in the occupational therapy courses was as follows:

Weaving—hand and bead looms, simple rug and mat making; woodwork—whittling and carving, confined to the use of a few instruments, as knife, chisel, and gouge; basketry—reedwork, and possibly pine-needle work; block printing—applied to both paper and textiles; knitting, crocheting, needlework, and beadwork; incidentals—cord knitting, rake knitting, etc.; applied design—to include the principles of design and color work and the application to subjects taught in course; practice teaching—actual practice in teaching the required subjects in hospitals under conditions similar to those which would be met in military hospitals; hospital routine and methods of invalid teaching, lectures and conferences on the conduct of hospitals, and methods of teaching the convalescent and disabled, including visits to institutions.

MILITARY SCHOOL FOR AIDES

In the latter part of July, 1918, the chief of the section of physiotherapy recommended to the Surgeon General that a school be established at once in Walter Reed General Hospital for the instruction of reconstruction aides in military physiotherapy because of the great difficulty in getting adequately trained women for that service.²⁰ The chief of the division of physical reconstruction stated in forwarding this recommendation that some civilian schools were giving a complete course for reconstruction aides while others were teaching only the fundamentals, and approved the recommendations for schools at Walter Reed General Hospital in both occupational therapy and physiotherapy.²⁰ It was not until well after the period under consideration, however, that such a school was established.

RATIO OF AIDES TO PATIENTS

In the early summer of 1918 the chief of the division of orthopedic surgery expressed the opinion that the influence and effectiveness of women in reconstruction work would be greater than that of returned soldiers, and requested

^a A specialized and intensive course was later given by Harvard University to 85 selected aides.

^b Courses in other schools had been approved—one in Boston, one in New York City, and a semi-official one in Washington, D. C., but were not yet being conducted.

the assignment of two occupational aides and two physiotherapy aides to each 50 orthopedic beds.²¹ This proportion was tentatively approved as an experimental basis by the chief of the hospital division of the Surgeon General's Office on July 2, 1918.²¹

STATUS OF AIDES

There was a great deal of dissatisfaction among the reconstruction aides because they were not on the same status as the nurses for pay and allowances.¹⁷ The chief of the educational department recommended an equal status for all trained women in the department who were of a corresponding assignment, except that the chief nurse at a hospital should be responsible for the discipline of all. This recommendation was not adopted.¹⁷

SOCIAL SERVICE AIDES

The necessity for social service work in military hospitals became increasingly evident. Many patients were so worried by family troubles, failure of payment of family allowances, morbid thoughts of their own, etc., as to interfere seriously with both their ability to recover and their willingness to remain in hospital for treatment. Experienced social workers were brought into the corps of reconstruction aides about the first of the year 1919 and assigned to such hospitals as requested them to act as head aides of the social service.²² Several adaptable reconstruction aides were to be assigned to each head aide as assistants; the duty of this service was to solve all possible individual problems of the patients through personal confidence attained and by securing cooperative action by welfare, insurance, vocational, and other departments through a knowledge of their requirements and of the benefits to which the soldier was entitled.

STRENGTH OF PERSONNEL

The educational personnel from October, 1918, to June, 1919, with the number of hospitals devoted to physical reconstruction during this period, is given in the following table:²³

	October	November	December	January	February	March	April	May	June
Number of hospitals.....	16	17	25	27	41	44	45	40	40
Commissioned officers.....	37	43	102	125	210	270	264	252	250
Enlisted men.....	335	314	695	681	809	888	808	750	603
Reconstruction aides.....	124	157	337	449	806	1,163	1,290	1,383	1,386
Total on staff.....	496	514	1,134	1,255	1,825	2,321	2,362	2,385	2,233

The personnel in the department of physiotherapy from October 1, 1918, to May 31, 1919, is indicated in the following table:²³

	1918			1919				
	October	November	December	January	February	March	April	May
Hospitals with facilities for physiotherapy.....	9	11	13	27	32	40	49	45
Commissioned officers.....	12	14	19	32	37	39	44	45
Enlisted men.....	25	29	36	40	60	75	60	54
Reconstruction aides.....	125	378	504	530	674	718	748	700

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SECTION II

IN THE AMERICAN EXPEDITIONARY FORCES

ORGANIZATION

Reconstruction in the American Expeditionary Forces did not become highly organized as it did in the military hospitals of the United States, nor was it intended that it should. It is true, however, that certain phases of it were to have been utilized to the fullest extent possible, and early in the organization of the American Expeditionary Forces. In the plan for the organization and development of the orthopedic department in the Surgeon General's Office, which was submitted to the Surgeon General on August 14, 1917,¹ provisions were included for the immediate formation of an orthopedic hospital of 1,000 beds for service abroad. This hospital was to be fully equipped with all facilities for physiotherapy and was to include a curative workshop. Within a few months, however, the idea of providing special hospitals for orthopedic cases was given up; thereafter, each hospital unit destined for overseas was to have an orthopedic section, with its curative workshop.² Furthermore, it was planned to provide sets of equipment to enable bedfast patients to keep employed and to ship these sets for such overseas hospitals as would have patients confined to bed for relatively long periods.³ One teacher was to be provided for each such hospital, with the expectation that the teacher would instruct wounded men for duty as assistants. For certain hospitals a part of the standard equipment was to consist of splint shops, carpenter shops, forges, etc., in which convalescent patients could be kept employed and at the same time make articles that would be of use in the upkeep of the hospitals.³ As will be seen below, however, even these modified plans were not consummated.

The majority of the patients in the American Expeditionary Forces requiring physiotherapy or occupational therapy were orthopedic cases. Reconstruction work, consisting principally of occupational therapy and physiotherapy, therefore devolved largely upon the orthopedic service. It was not practicable to provide for our hospitals in France curative workshops that could compare in number or quality with those shops furnished the military hospitals in the United States. There were two reasons for this—the restriction necessarily applied to ocean tonnage and the special classification of patients in the American Expeditionary Forces. Restrictions on overseas transportation, imposed by the limited tonnage available, also necessitated utilizing all personnel in the American Expeditionary Forces to the fullest possible extent. To this end instructions were issued in March, 1918, to convene disability boards, to classify all officers and soldiers coming before them in accordance with their degree of usefulness overseas, as follows:⁴ Class A, physically fit for combat duty; class B, temporarily unfit for combat duty but fit for other duty and expected to become class A within six months; class C, permanently unfit for combat duty but fit for other duty overseas; class D, unfit for any duty overseas, to be evacuated to hospitals at base ports for return to the United States.

This utilization of individuals not wholly physically fit in a limited service capacity and the return of the wholly unfit to the United States had a direct bearing on the overseas reconstruction problem, for, while it tended to reduce the load by evacuating to the United States the permanently disabled, this was counterbalanced by retaining in hospitals for months those who would become fit for limited service within a reasonable period. Furthermore, it afforded opportunity to retain overseas disabled men who would be of value as instructors in occupational therapy.

The first instructions covering a special class of cases requiring reconstruction concerned amputation cases and were issued early in April, 1918.⁵ These instructions required that all such cases be transferred to Base Hospital No. 9, American Expeditionary Forces, pending the establishment of the special orthopedic hospital, Base Hospital No. 114, at Beau Desert.

Reconstruction work was carried on also by other surgical services, the whole being correlated and coordinated through the chief consultant, surgical services.⁶ In the spring of 1918 the Surgeon General expressed the desire to send to France, to assume charge of the reconstruction work, a medical officer who had gained experience in this line by duty in the reconstruction division of the Surgeon General's Office.⁶ This plan was not approved by the chief surgeon, American Expeditionary Forces, as the organization there was considered to be satisfactory, and it was felt that better results would be obtained by continuing the work under the direct supervision of the individual heads of the departments concerned⁶ rather than by instituting a new division for this purpose in his office.

On May 3, 1918, the Surgeon General authorized the chief medical officer of each army or separate auxiliary force to appoint head aides not to exceed two to each hospital from among the reconstruction aides serving overseas.⁷ It was under this arrangement that the reconstruction service, American Expeditionary Forces, operated. There were no chief head aides, but there was one head aide who was in charge of the reconstruction aides in each hospital. There was a supervisor of reconstruction aides who, until January, 1919, was located at the Savenay Hospital Center.⁸ In January, 1919, she joined the chief surgeon's office at Tours and was affiliated with the office of the director of Nursing Service, American Expeditionary Forces.⁹

For the greater part of the fall of 1918 conditions in the American Expeditionary Forces not only caused a setback as regards the organization of the reconstruction service there but also made it practically impossible for the aides to carry on any of their work. The frequent arrival of convoys of troops from the United States during the fall of 1918, each transport having many cases of influenza on board, threw such a great burden on the hospitals near the baseports that the services of every available and suitable person were demanded for the care of the sick.¹⁰ Consequently, occupational work was practically abandoned during this time of stress and the reconstruction aides were called upon to act as assistants to the nurses. This was a valuable experience for the aides and promoted harmonious relations between the two organizations. In November, however, the need for such services declining, the aides were enabled to devote their whole time to reconstruction work.¹⁰

Efforts were made by the supervisor of reconstruction aides to so standardize the occupational therapy that uniform crafts could be used for all cases of the same type. It was felt that the work should be as simple as possible and that progressive interest could be maintained by the use of increasingly difficult designs rather than by introducing different varieties of work.¹¹

PERSONNEL

It was estimated by the chief of the orthopedic division of the Surgeon General's Office in the fall of 1917 that 400 reconstruction aides would be needed in our overseas hospitals for the first 1,000,000 troops actively engaged and 200 would be needed for each additional 1,000,000 men.¹² It was not contemplated at this time that any occupational therapy aides would be sent overseas, since it was believed such aides could be obtained from our overseas enlisted personnel.

The first aides to reach France were 22 physiotherapy aides attached to Base Hospital No. 114, which had been organized primarily as an orthopedic hospital unit.¹³ During the same month, however, arrangements were made by the War Department to send 28 additional reconstruction aides to the American Expeditionary Forces.¹³

The first occupational therapy aides to reach France from the United States numbered 13 and arrived there August 13, 1918.¹⁴ They were sent to Base Hospital No. 9, at Chateauroux, seven of them subsequently to be transferred (September 15, 1918) to Base Hospital No. 114, Beau Desert.¹⁴

In August, 1918, General Pershing recommended to the War Department that 20 reconstruction aides (10 physiotherapy aides and 10 occupational therapy aides) accompany each base hospital sent overseas, the aides to be reassigned for duty upon arrival.¹⁵ This recommendation followed a statement made by the chief consultant in orthopedic surgery, American Expeditionary Forces, that though there were then in France sufficient aides for massage, electrotherapy, and hydrotherapy for the needs at that time, there was needed a large number for bedside occupations.¹⁶ The neuropsychiatric division also expressed a decided preference at that time for aides trained in bedside occupational work with neuropsychiatric patients.¹⁷

A revised list of reconstruction personnel for each orthopedic hospital was formed in September, 1918, as follows:¹⁸

Aides in physiotherapy.....	26
Masseuses.....	20
Electrotherapeutists.....	6
Aides in bedside occupations.....	20
Hydrotherapeutists (men).....	4
Physical trainers.....	5
Shop instructors (men).....	10

The sending of reconstruction aides to the American Expeditionary Forces continued during the fall of 1918, and by the end of December, 1918, there were 200 aides there,¹⁰ distributed among 20 base hospitals.

Many invalided soldiers had been returned to the United States by February, 1919, and the orthopedic work was largely concentrated at Bordeaux and Savenay, thus permitting the return of a number of aides to the United States.¹¹

Seventy-one physiotherapy aides and 22 occupational therapy aides were serving in France at the end of February, 1919, with the hospitals at Angers, Bordeaux, Brest, Nantes, Savenay, and Vichy.¹⁹ The evacuation to the United States of patients who were in good condition caused a change in the proportion of the two classes of aides after February, there being in the American Expeditionary Forces on May 1, 1919, 54 aides in physiotherapy and 55 in occupational therapy; 13 of the former and 17 of the latter were in Germany with the Third Army.²⁰ The need for work in both departments was rapidly lessening, and aides were being transferred to Germany and to the United States. Thirty-two aides were on duty with the Third Army in May, 1919, at Treves, Neuenahr, and Coblenz, their work being principally with accident cases.²¹ The supervisor of reconstruction aides for the American Expeditionary Forces rendered her final report at the end of the month,²¹ and the last group of aides in France sailed for the United States late in May, 1919.²²

SUPPLIES

Special kinds of easily workable wood were at first supplied the hospitals for use in the curative workshops, but this was discontinued during the summer of 1918 owing to the demand for space in overseas transportation.²³ No provision had been made prior to the year 1919 for the general supply of materials for use in the wards and shops, so it was necessary to call on the American Red Cross to furnish such material as was available and to salvage and utilize such waste material as wooden boxes and tin cans.¹⁰ The American Red Cross also furnished much equipment, and the aides themselves financed the work to a considerable extent.¹⁰

PHYSIOTHERAPY

Since physiotherapy, as practiced at Savenay hospital center, is representative of the work done at its best elsewhere in the hospitals of the American Expeditionary Forces, the following account of that branch of reconstruction is reproduced:

DEPARTMENT OF PHYSIOTHERAPY

SAVENAY HOSPITAL CENTER

Reconstruction aides did not become a part of Savenay hospital center until October, 1918.²⁴ At this time a group of four aides was transferred from Base Hospital No. 116 to Base Hospital No. 8, at Savenay. To the last detail things were in a state of great activity; the wards were full; the staff was not large and was working to its limit. Plans were being made to enlarge the facilities for caring for the wounded. Just then everything was centered upon the influenza epidemic, for large convoys of influenza patients were arriving from the transports.

Notwithstanding all these pressing claims upon the attention of those at the head of the physiotherapy unit, time was taken to welcome the new group of workers and to assure them of hearty cooperation which has not failed. It was not possible to start work right away, so for many days the physiotherapy aides were employed at different occupations to lighten a little the heavy work of the nurses.²⁴

Gradually a system was worked out; a small clinic was obtained and work was begun with classes for ambulatory patients in the clinic and individual work upon those in the wards.²⁴ In hospitals which were already developing rapidly it soon became evident that four reconstruction aides could not begin to cover the work; therefore a group was obtained from Base Hospital No. 9, at Chateauroux, and in November another group came from the United States.²⁴ From this time on an average number of 30 physiotherapists was maintained at Base Hospital No. 8.²⁴

In December a new clinic was opened—a large, well-ventilated room with all equipment necessary for caring for the patients.²⁴ Patients who could walk came to the clinic for treatments. These were classified as follows: (1) Patients with median, musculospiral, and ulnar nerve injuries; (2) patients with knee-joint injury for thigh or leg massage; (3) patients with sciatic, external popliteal, or other nerve injuries of the lower extremities; (4) patients with elbow injuries for forearm, hand, or finger exercises. Where practicable, patients were grouped for curative exercises.

Under the direct supervision of the center consultant in orthopedic surgery, the cases were carefully diagnosed, a plan of treatment for each patient was worked out and changed from day to day as the patient's condition progressed, manipulation and exercise forming the basis of the work.²⁴

In the wards the work was supervised by the ward surgeon; the cases were classified as follows:²⁴ (1) Gunshot wounds involving joints; (2) gunshot wounds with fracture; (3) gunshot wounds with resulting nerve injury; (4) amputation; (5) head injury; (6) soft-part wounds; (7) closed fracture; (8) gunshot wound with loss of bone substance; (9) trench foot; (10) face.

Especially good results were obtained from this ward work, particularly on the hypothesis that "an ounce of prevention is worth a pound of cure." Previous to the war the general tendency in physiotherapy had been never to touch an injured member while there was any inflammation present. It has been found, however, that careful manipulation around a draining wound instead of checking actually hastens the recovery. In the case of fractured femurs where the limbs were practically covered with bandages and tape work around the patella and foot made a great difference in mobilizing the patient's limb when the splint came to be discarded. Of secondary importance to final results, but of primary importance to the patients, is the comfort and relief that follows a little massage given to men who have lain, strapped and tied, for months in most uncomfortable positions.

The following data, representing treatments given, show the increase in the physiotherapy work at the Savenay hospital center after such work was instituted:²⁴ October, 1918, 1,426; November, 1918, 3,440; December, 1918, 5,251; January, 1919, 6,568; February, 1919, 6,528; March, 1919, 4,333; April, 1919, 4,218.

During the winter of 1918-19 a course of lectures was arranged for the reconstruction aides.²⁴ These lectures were given by the various surgeons at the center and embraced subjects which would give the aides information and advice for the cases under their care. The program was as follows:²⁴ (1) The pathology of contracture deformity; (2) the surgical correction of contractures;

(3) the correction of contractures by massage and nonsurgical methods; (4) deformity of upper extremities due to soft-part wounds, including amputations; (5) deformities of upper extremities due to bone and joint injuries; (6) the use of splints and plaster of Paris in injuries and deformities of the upper extremities; (7) deformities of the lower extremities due to soft-part wounds, including amputations; (8) deformities of the lower extremities due to bone and joint injuries; (9) the use of splints and plaster of Paris in injuries and deformities of the lower extremities; (10) massage treatment of arm and hand wounds before and after operation; (11) the massage treatment of thigh and leg wounds before and after operation; (12) mechanical treatment of joint injuries.

The progress of physiotherapy at this center was not contrary to that of other lines of work;²⁴ it was retarded here and there by unforeseen events and helped along by other circumstances. Despite changes in personnel and organization, the work continued steadily until the discontinuance of the center.

OCCUPATIONAL THERAPY

AT BASE HOSPITAL NO. 9²⁵

The first unit of occupational therapy aides to be sent to France arrived at Base Hospital No. 9, Chateauroux, August 14, 1918. No arrangements had been made for the reception of the unit, so that it was not possible to begin reconstruction work at once. For this reason, the members of the unit did nurses' aide work for about three weeks. At the end of this time the chief consultant in orthopedic surgery, American Expeditionary Forces, showed a personal interest in the work, and the aides were permitted to begin occupational therapy. They were first allowed to do ward work. The chief difficulty here lay in the lack of proper materials, as this unit had been sent to France without any equipment and without funds to carry on the work; however, the aides themselves supported it out of their own pockets for a few months until they were able to get the work on a self-supporting basis.

Each day the unit, comprising 1 head aide, 1 aide in charge of tin-shop work, 1 in charge of woodwork, and 4 ward workers, reported at 8.30 a. m., had until 9.30 to prepare work; went on duty in the wards at 9.30 and stayed until 11.30. They then worked until lunch time on preparation. At 1.30 p. m. they returned to the wards, stayed until 4, and then spent from 40 to 50 minutes on preparation. At 5 o'clock they were released for the remainder of the day. They did not work on Sunday except when put on nurses' aide duty. The aides were allowed one afternoon each week free. That afternoon was largely spent in shopping for the patients, the town of Chateauroux offering very little in the way of amusement.

The first space allotted to the aides was the corner of a small room.²⁵ This was for the storage of supplies and the preparation of work. At first the equipment consisted of one claw hammer and one old fancy French plane; the materials were pasteboard boxes and empty tin cans. The aides made their own looms, rakes for knitting, and in fact everything that was used, until one day it was discovered by them that there was a reconstruction shop at the station. The shop was fully equipped and helped to advance the work. Men were allowed to work in the shop, and they helped in a great many ways, planing boards and getting the rough material ready.

The work had to be stopped when large convoys of patients arrived and the shop was used to house some of the patients for whom there was not room elsewhere in the hospital.²⁵ The aides helped in caring for them.

Finally a medical officer was placed in charge of the reconstruction aides, and the patients were sent to a small shop which had been constructed in a corridor of the hospital. Here two types of work were done—tin work and woodwork. The patients at this time were what were termed hand cases—that is, they were men with gunshot wounds of the arm, forearm, or hand. Patients were sent to the shop as soon after operation as possible and were assigned some simple form of work which required practically no muscular effort, but enough motion to keep the small muscles in tone and to prevent the hand and arm from becoming stiff and atrophied.

The curative side of the work was started as soon as the men were able to work in the ward and then was continued in the small shop until they were able to go to the regular curative workshop, the work done in the small shop being of a very light kind.

Some time in October, 1918, the curative shop, formerly in charge of enlisted men, was turned over to the occupational therapy aides. In operating this shop the policy of the aides was always to give each patient a definite time at the prescribed work; the rest of the period of the day was given over to making up into some definite article the material upon which he had been working. Thus the interest of the man was kept up. The officer in charge would send all patients to the aides and then visit the patients twice a day to examine them and suggest the kind of work that was best for them to do.

In the American Expeditionary Forces hospitals there was no educational department, and the aides were directly under the orthopedic surgeons and worked under their direction. The curative work in Base Hospital No. 9 was the side that had most stress laid on it. In leg injuries it was a mere matter of occupational therapy and not of curative therapy. The leg cases in the shop were taken care of mostly by the use of the jig saw, lathe, and a grindstone. Two jig saws were used for ankle work, one which flexed the knee, and the lathe which acted both on the ankle and the knee. The arm and hand cases were put on light work—the use of pliers and hammer, wood carving, and general carpentry.

In right-arm amputation cases the left hand was trained from the very beginning by clamping a piece of work on a bed tray. First the patient would start with simple painting, when it was a question of merely holding the brush, and following a line. From that he advanced with the work so that when he was able to leave the bed he had acquired a degree of skill with his left hand. In a case of double amputation of the hand the man would first be taught to feed himself by means of a spoon and fork inserted in straps on his forearms. Then an appliance made of wire with a knob at the end was inserted in place of the eating utensils so he could use the typewriter. He also was taught to write by inserting a pencil in the strap.

When the patients made articles in the shops an arrangement was made with them to duplicate the articles. One of these they could keep; the other was for the shop. In this way the shop was kept supplied with articles which could

be sold. If a patient became very ill or was going to leave the hospital before he could finish the second article he had the privilege of buying the first one at cost.

WARD WORK

KNITTING

Occupational therapy aides considered rake knitting the lowest form of work that an injured man could do, and they always tried at once to get a man to do some higher grade of work. However, this occupation proved particularly useful in empyema and heart cases and for men who had very low vitality or were weak. Nearly every patient knitted a cap for himself.

SIMPLE WEAVING

The weaving done was of the simplest type and most of it was done on handmade looms.

BLOCK PRINTING

Much of this work was done by bed patients. The men themselves cut the blocks of wood and made many postal cards of the scenes in the little town of Chateauroux—the small, low houses with the red roofs, the odd little donkey carts, and the usual town square with the church. In addition to the postal cards the patients printed material used for books, table covers, and children's bibs. It was an interesting process and one that kept a man busy for quite a while, because cutting the block itself took considerable time. Block printing was used to a great extent in cases of wrist-drop, for it required the man to stand up and press with his fingers many times to each impression.²⁵

BEAD WORK

Quantities of bead chains were made by the men. Bead chain making was used chiefly with cases of gunshot wound of the hand or arm. It required great concentration and coordination of the small muscles in the hand which so easily atrophy from disuse. If a man felt he could not use his hand or arm at all he was given bead work, which had to be watched so closely that soon he forgot he was using his hand and thus gained valuable exercise. It required no muscular effort and was not injurious to open wounds.

WOOD CARVING

Wood carving required very little muscular effort, especially if the work was clamped down. At the same time it required a variety of motions. The men made many trays, picture frames, boxes, book ends, bag handles, and pin trays.

LEATHER WORK

From leather the patients made traveling cases, musette bags, and, after the finding of some pieces of gray suede, some pocket books. The men in the shops made metal handles in order to complete the bags. This work was done by practically all patients and was especially helpful for wrist-drop, as a certain amount of pressure is necessary to do the work.

EMBROIDERY

The men did a great deal of embroidering, and it proved that the more severely a man was injured the more he liked to embroider. Cross-stitching was given to men who had lost one arm. The work was clamped down with thumb tacks to a wooden frame or a bed tray. In this way a patient could get both sides of the work with one hand.

PLAQUES

Plaques were made containing little French scenes. The scene was outlined with a very fine carving tool and then it was painted in flat color. This kind of work became very popular, for all the men enjoyed painting.

TILES

Red French tiles were procured and decorated; they were then varnished and used for tea tiles.

WORSTED AND RAFFIA WORK ON CANVAS

Some very attractive bags were made of worsted and raffia on canvas.

BEADING

Sealing-wax beads were made in large quantities and used as ornaments for bags.

SHOP WORK

TIN WORK

In the beginning of occupational therapy work at Base Hospital No. 9 the only tin that could be secured was empty tin cans from the kitchen and commissary. From these empty tins the patients made dustpans, which could not be bought in France and of which the hospital had none. The patients also made ash trays, match holders, and all kinds of toys, such as automobiles and fire engines. Finally one of the patients succeeded in getting an old copper tank from a friend in the Aviation Corps. From this the patients made bag ends, desk sets, paper knives, etc. Rubber tubing was used as tires for automobiles, and whistles on steam engines were made of cartridge shells and the bulbs from atomizers.

BRASS WORK

A small piece of thin brass was procured and it was fashioned into brass flowers. The flowers were used as ornaments on metal bowls.

WOOD CARVING

Much wood carving was done; trays, book ends, penholders, workboxes, tool boxes, picture frames, desks, chairs, and cabinets were made. Such things as tool handles, electric lamp standards, candlesticks, and wooden tools were turned out on the lathe. Sets of toys and small theaters were made; they were cut out on the jig saw and then taken to the wards to be sandpapered and painted by patients confined to bed.

Seventy-five millimeter shells were made use of for candlesticks, vases, and ash trays; 1-pound shells for candlesticks, table bells, and dinner gongs;

155-millimeter shells were fashioned into jardinères, large ash trays, the foundation for large, five-branch candlesticks, and handles of riding crops. Rifle bullets were used for the handles and tongues of bells. It was found that the hammering of the metal gave exercise to stiff wrists and required hours of work; in cases where flexion and extension were most needed this was assigned.

Attractive bag ends were made from the shells which were flattened out and then hammered into shape from the wrong side.

A large part of the brass secured was used in making brass handles for wooden trays, handles for bags that were made in the wards, also brass blotter corners.

MACHINES

Certain machines in the curative shop were used for leg cases. These machines comprised an old wooden lathe and three foot jig saws, two of which exercised the ankle and one the knee. There was also a large grindstone which was made adjustable and used for knee work. On this the men sharpened the bread knives, meat knives, axes, etc., for the hospital.

The shop also contained a large adjustable hand drill which was used for shoulder and elbow cases, the handles being put up or down according to the degree of motion desired. There were hand drills that were used to improve the grip. In instances where men were unable to grip their hands were covered with gloves and then tied to the hand drills. In this way the muscles would work unconsciously in the beginning.

The emery wheel, which was ball-bearing and required very little exertion, was used for men who were very weak and had practically no grip.

Sawing, especially of firewood, was recommended in shoulder cases. The men never liked it very much as it was too much like real work; however, it was one of the best exercises that could be recommended.

AT SAVENAY HOSPITAL CENTER

The following account of occupational therapy, as conducted at the hospital center, Savenay, is taken from the history of that center:²⁴

When the aides arrived in Savenay they found the hospital extremely busy and needing assistance in many lines. The management of the making of plaster bandages was put in charge of one aide and the gauze-dressing room was given to another. For the first few weeks, until more nurses arrived, we did nurses' aide work for two hours in the morning, and, in emergency, helped make and apply splints and plaster bandages. For occupational therapy work we were given a corner of a room, a chest of tools, and later a box to put materials in. With materials salvaged from all departments of the center and a few things bought with our own money we started the work. From this small beginning the work increased until in January we had a small room for the aides to prepare work, and a large shop, formerly the post office of Base Hospital No. 8, where curative work was done.

The purpose of the work in occupation is twofold: (1) To divert the mind from suffering and occupy the patient and bring back a more normal attitude; (2) to work with physical disabilities in cooperation with the physical therapy aides, giving definite work for improving injured hands, stiff wrists, elbows, shoulders, ankles, or knees. The leg disabilities, of course, can only be treated in the shop.

The following crafts have been used in the wards or in the shop: Metal work in tin, lead, copper, brass, wire gauze, etching of shells, woodworking, rough carpentry, boxes and book-racks, wood carving, chip carving and low relief, block printing, designing, cutting blocking paper and cloth, painting, water-color card, oil panels and types, lathing, rake knitting,

macreum cross-stitch, embroidery, weaving, tapestry, basketry, reed, rush, raffia, leather work, tooled, painted, cut, toy making, metal and wood, bust work, string work, bookbinding. When in good running order 300 men on the average were kept busy every day.

FINANCING THE DEPARTMENT

* * * * * *

We, like all the other occupational aides, arrived in France minus all tools and materials except the few treasured ones each brought with her and minus the means of procuring them unless we bought them ourselves out of our salaries.

Added to that was the general lack of knowledge regarding us and our work. It was new and therefore unnecessary, perhaps even frivolous. Therefore, we were tucked away in odd corners—some of them very odd—to sleep, and put to work on the wards, making beds, giving baths, and being generally useful.

Savenay was no exception. We were nurse's aides in the morning and reconstruction aides in the afternoon, leading a rather strenuous life. One aide was placed permanently in the surgical dressing room, one to oversee the making of plaster bandages, and a third as assistant in the department for putting on and adjusting casts and splints. The latter was relieved after three weeks and became assistant in the curative workshop. The other two were not so fortunate. After about a month the occupational work was recognized and the aides were allowed to devote all their time to it. The sale, given after two weeks' work, was quite remarkable, as most of the materials were salvaged. They were extremely pretty, too. There were candlesticks made by soldering the tin spool for adhesive plaster onto the cover of a plaster can and giving a cheerful coat of paint. There was a loving cup, shown by close inspection to be an inverted ether can on a candy-box cover. There were shopping bags of unusual wrapping paper, with rope handles; toys from cigar boxes and carved wood from Quaker Oatmeal boxes. Our "official rustler" was known all over the hospital, from the supply house to the dump. Every corner yielded a treasure. An empty can was a future rowboat; discarded floor tiles made wonderful palettes, and many a painting was made on them. Silver paper from chocolates was melted into lead soldiers, the end of a crutch became a lighthouse.

More men began to work and the need for money became desperate. We appealed to the American Red Cross for 250 francs, and with their usual generosity in emergency they made it 750.

That first real money loomed as big as a fortune. Only once afterwards did we feel so overwhelmingly wealthy, and that was after an auction which the American Red Cross managed for us and which netted about 2,000 francs.

A sink appeared and was installed by a plumber. One of the 17th Engineers, a private, helped us day after day and week after week till our path became easy. One after another he supplied every necessity, making many unusual tools—making even a soldering stove and irons. We never could have built up the shop in so short a time without him.

Well, there came a day when the one little room could hold us no longer, and we begged for more space and more money. It was a wonderful day when the colonel said he would see that we got both. He moved the post office and the fire warden, and through a hole in the partition of beaver board our excited eyes saw empty space, clear to the end of the barracks. It seemed as if we never could fill the space.

They built us more carpenter benches, more stools, put up more vises, and with the American Red Cross definitely behind us, paying whatever bills we were unable to meet (for the work was, of course, never self-supporting), we finally became well equipped with tools and well stocked with materials.

A fine assortment of whitewood and gumwood, requisitioned in the United States six months before and given to us, filled the last need. We could leave behind us the days of tin cans and Quaker Oat boxes and turn out work that was really fine and artistic—carving, block printing, embroidery, painting, work in wool and raffia, and beads and velvet.

Every week now the "official rustler" could go to Nantes and shop all day, bringing home hundreds of francs worth of paints, knives, needles, embroidery cottons for knitted bags, straw baskets to decorate—in fact, everything that 300 people a day could use in,

it seemed to her, as many different crafts. Her list usually contained one or two nerve-wearing articles, like asphaltum varnish or butter of antimony, or jig-saw blades, or a bullhead stake.

Toward the end of the work a carload of brass ammunition shells came, given us by the Red Cross, and a supply of copper and leather from the orthopedic departments.

I have said that we were not self-supporting. Of course, the first few months of any business are bound to be all expenditure and not return till the equipment equals the demand, and, of course, our work is not to make money—it is to help mentally and physically. Nevertheless, for the last few weeks we have needed practically no help, and if it were not for the number of very valuable articles which we are obliged to keep and send to the International Exhibition at Rome we should be well ahead financially.

At present we have nearly \$200 in the treasury. We have never had but the one auction, lest we acquire the reputation of being commercial. Since then there have been sales as often as convenient, sometimes for officers and nurses, sometimes for the patients, and sometimes for everyone.

Our method is this: For every article a patient makes for himself he makes one of equal value for the shop. He pays nothing for his own, and we sell the other for enough, if possible, to cover the cost of both.

If he has only time to make one, he pays for the materials. If he wants both, and is going home, he pays a little more than the material costs. Other shops have used other methods. Some have paid the patients for their labor, some have shared the profits, some have allowed the patients to make and sell what they chose. But we felt that the exchange of money was rather to be avoided, considering the purpose for which we are here. And to give them materials and the use of the shop for nothing is demoralizing.

TATTING AND BEAD WORK

I was rather dubious about the place of tatting in a hospital for wounded soldiers, but when I found men on my ward who had use of their hands but who could not raise even their heads from the pillow I made the experiment. The first man I approached with a tatting machine was (I learned later) a plumber, steam fitter, and coal miner in civil life, and I would not have been surprised if he had told me politely but in unmistakable terms that he would see me further before he would learn tatting. I had one of the surprises which one comes to expect in ward work, the kind of surprise that encourages adventure in new paths. My plumber took kindly to the tatting shuttle, and during his stay on the ward made yards and yards of tatting which was used to finish bags and scarfs made by other men on a hand ward. I sometimes feared that he would tire of endless tatting for other men's bags, but I need not have worried. Several times I tried him on other work which I thought might prove more interesting, but each time he quietly returned to his shuttle at the first opportunity.

After this I tried tatting with several other men, and I have never seen a man refuse to learn.

I never had the opportunity to use tatting with a hand case, but I do not see why it might not be valuable as a wrist and hand movement in helping to gain flexibility. For bed patients it has the advantage of being light and easily handled, and while it causes no mental effort it carries with it the sense of having mastered something intricate and the satisfaction of using one's fingers in a deft fashion.

In my ward there was a Greco-American, a candy maker, named Sam. He told me he could make me a thousand pounds of candy if I wished, but he couldn't do the work the other patients in the ward were doing. Bead jobs attracted him, but he didn't want to make one. I threaded a loom and left beads, loom, and a pattern at his bedside, but he only laughed at me for expecting him to do the work. The loom stood around conspicuously untouched for a day. The following day I placed the loom on Sam's bed when he was out, but it was not until the day after that I heard from Sam. He asked me to thread him a needle and I knew the work had started. After Sam finished his first job he asked for beads for another, and it was while he was working on this that I heard him say, "It's funny what a fellow will do in the Army."

COLOR WORK

The inborn love of color that is in almost everyone seems to make painting appeal to a surprisingly large number of patients. It offers an especial diversion to men having but one arm to use, and that a left one. The necessity to keep within certain bounds of the design, the constant study of tone values, and the control of the light brush make the occupation a thoughtful one.

Such men as miners and farmers, who have never had an opportunity to paint before, take pleasure in expressing themselves by certain assemblings of color.

The city boy paints bricks into his houses; the Italian arches the windows and doors; the country lad makes his into a barn; the Mexican sees his of pink and yellow plaster.

The choice of designs, of cards, tends toward figures and houses and scenes of natural healthy life. After the first card the patient begins to realize that skies are not always blue, that buildings are not always brown. He finds that, from the same design, he can produce a night scene or a day in spring. Then his imagination begins to play—eked out by his observation and social inheritance.

Nature means much more after he has tried to imitate her. The same colors that vibrate in the rainbow are echoed in a Coney Island crowd. A man who for some weeks has been unconsciously absorbing colors, masses, lines, and shapes will see new beauty in the details of his everyday life. The greatest value of the work is the patient's heightened perception.

J. A. was a Spanish miner from Socarro, Mexico. He had received no letters from his wife since arriving in France and carried a picture of his only little child that had died.

J.'s foot had been badly wounded, which obliged him to lie on his back for many weeks. Painting of a small card was the first occupation given to him, and pleased him so well he never wished to do anything else but paint. At Christmas time he did consent to make many Jacob's ladders for the ward tree, but resumed painting immediately afterwards and painted up to the day of his departure for the United States.

J. had an unerring sense of color and an innate feeling for design. He had never painted before, but stored within his mind was a wonderful collection of images and a childlike imagination. Simple designs were given to him, mere cutting of spaces; to them he added strange rich flowers and an embroidery of delicate leaves. Large block-printed cards he made into panels of beauty, with his personal touches of flower vases, fruit trees, window panes, and spotted dresses on the ladies. He liked to have a new thing to paint and smiled with delight at animal designs. The reconstruction aide on his ward was kept busy thinking up patterns. No matter how bizarre her ideas appeared to outsiders, J. always understood and interpreted them. One day he painted a delightful tile of an animal. One half of the tile represented the antelope, in his summer coat, grazing on yellow flowers; the other half showing him in his winter coat, feeding on scant herbage.

Another tile had many small animals on it. J. thoughtfully painted each one as he saw it, making a fox into a skunk, a kangaroo into a coyote. In one tile he put a Spanish vase, two pitchers and flowers, all in the Mexican glowing colors of red and yellow and orange.

He always changed a thing to better it, and constantly his brush would wander into new bypaths of fine color. He painted book ends, cards, tiles, tin boxes, candles, toys, wool bobbins, and never failed. He used water colors, oils, and enamel paints, never messed his palette nor spilt his colors, but painted in a fastidious manner, using a small pointed brush.

He said he intended to have a box of colors of his own to paint some pictures on the walls of his Mexican home.

K. termed himself the worst-tempered man in the American Expeditionary Forces, but that was a pose. He became interested in the bead chain belonging to the man in the next bed and wanted to make one also; so he was started on a chain of his own and worked faithfully, but rather ungraciously, until the chain was almost completed, when he lost the beads necessary to finish the job. I tried to impress on him the fact that he should have taken better care of the materials intrusted to him, but with little apparent effect. Later in the day the surgeon on the ward noticed K.'s woe-begone look and went over to cheer him up—laying his blue look to the pressure pads on two fractured femurs. He discovered

however, K.'s gloom was due to the loss of the beads. Later the beads were found, and that was the first of three chains made by K. The third chain went along to be finished on the homeward trip.

B. was disconsolate. The doctors hurt him when they dressed his wounds and he was in a great big frame with all kinds of ropes around him (a Balkan frame). Life was very hard on him, and he did not care to talk to anyone.

H., in the next bed, was about as badly off, but he was making some knots around a board, which he worked at everlastingly. It finally turned out that the knotted thing was to be a bag. H. was delighted with it and it had a lovely lining. H. also said it made him feel better to be moving his hands and thinking of something besides his troubles.

I persuaded B., after many rebuffs, also to try something, with the understanding that he could stop at any time he got tired. I gave him some weaving with pretty colored thread, and ever after B. was a changed man. He still was in pain and the doctor still hurt him, but the bag progressed. It had an attractive little border, and in his eyes was much prettier than H.'s.

B. worked with and for me for six months afterwards. He made many bags of wool and raffia. He did block printing, also knitting, and made a great variety of things. He enjoyed his work and did not like to be without something to occupy his mind while he was in the hospital.

M. was a carpenter. He was all roped in bed when I asked him if he wished to make something. He laughed and said he did not know what he could make. I suggested several things, which immediately aroused his interest, and the next day he was busily engaged with a knife and some soft pieces of wood, whittling, although flat on his back. It was very difficult to keep the shavings out of his neck, but he never complained. He used to sing as he worked, although the pain was very intense at times. He made letter cases at first. Later, when he could sit up a little, he made a windmill. He had two operations after he did his first piece of work, but as soon as he could possibly do it he had a knife in his hand again, dodging his ropes, his bed covered with shavings, and a smile on his face. He used a fret saw also and constructed some of my best toys. He tried mechanical drawing and made some very good letters, also drawings of different joints. He wrote me a nice letter about the value of occupational therapy before he left for the United States.

B. came to us as an "up patient," having had his right hand amputated. He had been in the ward only two days when he followed me to my source of supplies and asked for some cord. I gave him a ball, and half an hour later he had his bed covered with twisted cords and tassels, or "pompoms," as he called them, of various sizes and designs. It was wonderful to see him work, using his stump, his mouth, and his left hand. The other patients were fascinated with his performance. He seemed to like the feel of wool especially, and when he had made draw strings and pompoms for everybody who could possibly need one I gave him some embroidery to be done in wool. He managed to hold the frame with his stump and showed great dexterity in the use of his left hand. He refused all assistance, threading all his needles and correcting his own mistakes. His work was perfectly done, and he added to my design some little touches that seemed characteristic of his Greek ancestry. He seemed delighted to handle material, and expects to return to his work as a maker of cords and tassels.

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- (25) Report of the activities of the reconstruction service, Base Hospital No. 9, Chateauroux, by Miss Susan Hills, head aide. On file, Historical Division, S. G. O.

SECTION III

IN MILITARY HOSPITALS IN THE UNITED STATES

CHAPTER III

IN GENERAL AND BASE HOSPITALS

INITIATION OF RECONSTRUCTION

Though one phase of reconstruction—surgical treatment with its after-treatment—was carried on at all times during the World War, the beginning of the execution of the reconstruction program of the Medical Department in the military hospitals occurred early in 1918,¹ when organized efforts were initiated in a few general hospitals. Necessarily, these early beginnings were crude as to organization and equipment, for the reconstruction program of the Surgeon General had not yet been approved by the War Department, and in consequence funds were not directly available for personnel, equipment, and buildings. Such facilities as were available or could be obtained from sources either military or civil were adapted to the purpose and reconstruction was undertaken in a small way. This stage fortunately occurred before any battle casualties arrived from overseas, so the experimental period largely had passed before the great need for the service occurred.

The first definite instructions concerning the operation of reconstruction services in hospitals were published by the Surgeon General in March, 1918.¹ In accordance with these instructions all therapeutic work, excluding physiotherapy, was to be classed as occupational therapy, and divided into (a) ward occupations, for men confined to bed or to invalid chairs, consisting of handicraft and educational activities; and (b) such other work in the shops, on farms, etc., as could be performed by more active patients. It was also provided that a selected chief educational officer, usually from the Sanitary Corps, was to be assigned to each hospital operating a reconstruction service and to have charge of the assignment of aides for ward occupations and immediate charge of the curative workshop schedule. No patient was to be assigned ward occupational work until the ward surgeon had entered on his clinical record the fact that he was physically fit for such work, and no patient was to be assigned to work in the shop, on farms, etc., except on written prescription of the proper medical officer, such prescription to state the functional result to be obtained, the length of time the patient should work, whether the work should be light or heavy, and whether indoors or outdoors. The selection of the type of work which would best fill the prescription was to be left to the chief educational officer. Equipment and raw material for carrying out the curative workshop schedule were to be obtained on requisition as medical property.

Originally it was planned to construct special buildings to house the reconstruction work,^a and such buildings were furnished at a few places, but the great majority of hospitals had to adapt to the purpose such buildings as could be made available.²

^a The plan of the special U-type building for physiotherapy is shown in Vol. V of this history, p. 82.

The general hospitals designated in April, 1918, as reconstruction hospitals were to have the following personnel:³ (1) An educational officer, to be assigned by the Surgeon General's Office, who was to have charge of the curative workshop schedule; (2) reconstruction aides, class 2, teachers of handicraft, assigned by the Surgeon General's Office; (3) teachers from enlisted men already in the service who were physically not qualified to perform full military duty but who were mentally and temperamentally qualified for this work, such men in other branches of the service to be transferred to the Medical Department on a "partial duty status"; (4) The local organization to conduct a recruiting campaign for enlisted men for the same purpose; (5) employment of civilians as teachers if necessary.



FIG. 1.—Occupational therapy in the early stages of its use in the Army

The educational officer, under the general directions of the commanding officer, was charged with the employment of all patients whom the chiefs of services considered would be benefited by the work.³ He was to assign them such work as would fill the requirements of the prescriptions written by the medical officers and to report to and confer with the latter on the results accomplished. A tentative minimum list of necessary equipment and raw material was supplied, such property to be issued by the property officer to the educational officer as required.³ All finished articles made from material supplied by the Government were to be turned in to the educational officer for such disposition as should be directed.³

In order that patients who needed reconstruction could be centered in the designated general hospitals where the necessary facilities were available, the

commanding officers of all base hospitals were notified on May 21, 1918, to transfer to general hospitals all patients who might be benefited by special treatment not available at base hospitals.⁴ Patients who were blind, were totally deaf, had had amputations other than fingers and toes, or had pulmonary tuberculosis were specifically mentioned for transfer.

TYPES OF WORK PROVIDED IN JUNE, 1918

The following types of minor craftwork were offered in occupational therapy in June, 1918: Basketry, weaving with hand and bead looms, design, block printing, wood carving, knitting by hand and with machines, toy making, leather work, and the making of mops, bags, nets, etc.⁵



FIG. 2.—This and Figures 3, 4, and 5 show minor craft work for patients confined to bed

There was some criticism of the type of work employed on the grounds that it catered to the superficial interest of the men, was too childish to attract mature men, and that the continued occupation with it tended to hospitalize the men and prolong their confinement to the ward.⁶ It was also contended that the employment of female reconstruction aides was inadvisable, as it was difficult to coordinate them with the rest of the hospital organization, and it was not desirable to employ women in this type of work in military hospitals. These contentions were disproved by experience as the occupational work became better organized.⁵



FIG. 3

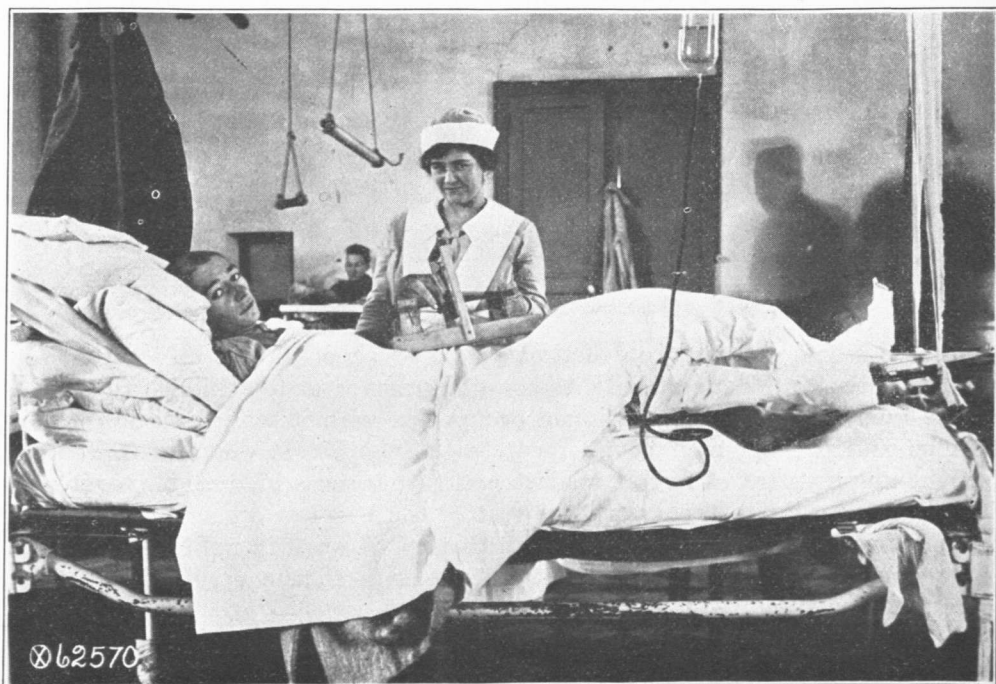


FIG. 4



FIG. 5



FIG. 6.—Handicraft—toy making

ADMINISTRATION OF THE CORPS OF AIDES

At this time (June, 1918) it was decided that all work by reconstruction aides should be administered under the immediate supervision of the hospital educational officer.⁵ To this end a special form, the physical reconstruction register, Form 58, was devised and approved in July, 1918. This form was filled out for every man admitted to a reconstruction hospital, and the filed copies later formed the bases of studies of our war experiences.⁵

Instructions for the classification and administration of the personnel of the corps of aides were issued by the Surgeon General on September 27, 1918.⁶

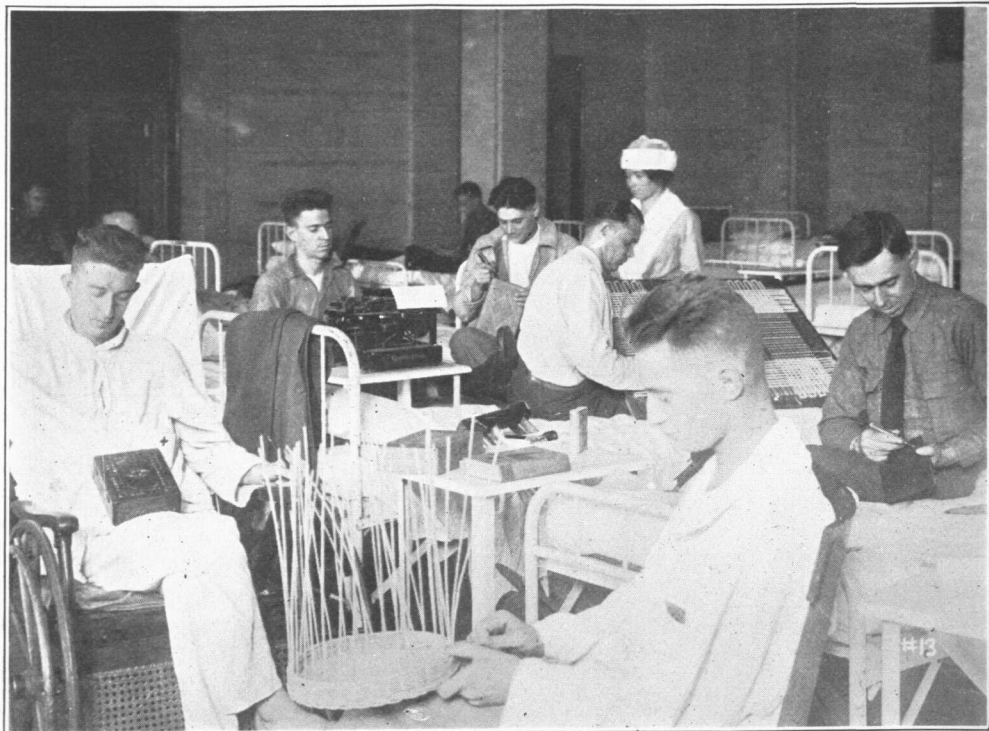


FIG. 7.—Occupational therapy—ward work

In accordance with these instructions, women appointed to teach handicrafts and other subjects to patients in military hospitals were to be called "reconstruction aides in occupational therapy." Reconstruction aides in occupational therapy were to be divided into three classes—aides, head aides, and supervisors. Whenever two or more aides were serving in a hospital, one of these was to be designated as head aide and was to have authority in all matters of administration. Junior aides were to work under her direction. Where more than 10 aides were serving in a hospital, there was to be an additional head aide. Where two or more head aides were serving in the hospital, one of these was designated as chief head aide and was to have general supervision of the work. The function of the other head aides was to be the supervision of particular portions of the work under the general direction of the chief head aide. When the organization became complicated, a supervisor was appointed to have

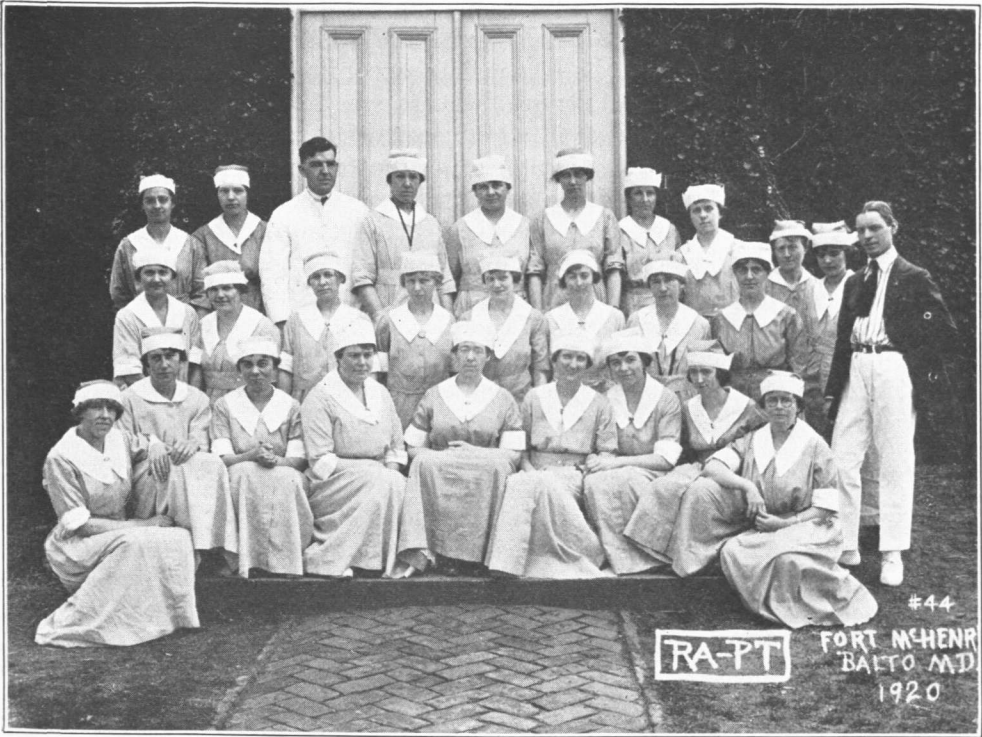


FIG. 8.—Group of physiotherapy aides, General Hospital No. 2, Baltimore



FIG. 9.—Group of occupational therapy aides, General Hospital No. 2, Baltimore
37046—27——7

administrative authority over all other aides. In general hospitals where there was a chief of the educational service the supervisor, chief head aide, head aides, and aides were to be responsible, according to their proper ranks, to the chief of the educational service. There was to be necessary oversight by the medical officer, as in case of all educational work, and through him to the commanding officer of the hospital in all matters relating to the content, method, and administration of the work. Where there was no chief of the educational service, the head aide was to be directly responsible to the chief of the clinical service in which the work was being done. In all cases the work was to have the necessary supervision of the medical officers of the hospital. In personal matters and in matters of conduct, both on and off duty, all reconstruction aides in occupational therapy were to come under the jurisdiction of the chief nurse of the hospital. In these matters they were to be subject to the same rules and regulations as nurses.

COOPERATION WITH THE FEDERAL BOARD FOR VOCATIONAL EDUCATION

The Federal Board for Vocational Education was not directly concerned with the vocational education of soldiers previous to their discharge from the military service, but admission of its representatives to reconstruction hospitals was authorized in order to coordinate the education of individuals in hospital with the educational courses to be given after discharge.⁷ On September 25, 1918, the Surgeon General notified all commanding officers of hospitals functioning in reconstruction work that the educational work in hospital was under the charge of the Surgeon General's Office, whether given for therapeutic purposes or for vocational preparation for special or limited Army service, and directed that the commanding officer of the hospital give all necessary cooperation to the representative of the board, under such regulations as the commanding officer should make, in the case of men who would be discharged from the military service after completion of their hospital treatment.⁷ It was suggested that the representative of the Federal Board for Vocational Training be furnished an office, given access to patients who had been recommended for discharge for disability, such men's educational and vocational history, both personal and of work performed, and such recommendations as to their future education or occupation as the educational officer might care to make. No military or medical histories would be furnished, as this was contrary to Army regulations, nor was permission to be given the representative to interview patients in the wards. While the Army was making every effort to prepare men for military service, it was considered inadvisable to permit the promiscuous circulation in hospitals of the representatives of an agency which was necessarily concerned solely with the training of men for civil pursuits and who were required to make the opportunities which they offered as attractive as possible.

THE EDUCATIONAL SERVICE IN THE FALL OF 1918

An educational service was well established in 17 hospitals by November 15, 1918, and less completely in 3 additional hospitals.⁸ The different classes of work that were to be given at this time, were as follows:⁸ (1) Bedside occupations to take the patient's attention from his disability and occupy his mind.

At first diversional and entertaining, these became definitely vocational, economic or social in value. (2) Ward, shop, or farm occupations and study to occupy the patient's time in worth-while work, and thus develop in him a good mental attitude toward his disability, his treatment, and the hospital. (3) Ward, classroom, or farm operations and study in preparation for reeducation, for those entitled to reeducation, under the Federal Board for Vocational Education.

An average of about 38 per cent of patients in a reconstruction hospital were enrolled in the educational service courses at the time in question, but this figure is probably considerably higher than that of the actual attendance



FIG. 10.—Occupational therapy when fully organized—weaving room

at classes, for which no figures are available.⁸ Handicrafts were slightly over 50 per cent more popular than academic study in the wards, while academic subjects and games and exercises had the largest enrollments for those who were not confined to the wards.⁸ Enrollment in educational classes was voluntary, and the size of the class depended largely on the popularity of the instructor. Later it was considered advisable in many hospitals to adopt some form of compulsory attendance, the withholding of pass privileges or the assignment to some hospital duty being the penalty for failure to participate in the educational work.

Instructions were formulated in the fall of 1918 and later published as a handbook which completely covered the duties of officers in the educational department and their relations to other departments of the hospital.⁹ Chart II

shows the organization of the educational service in a hospital at the time in question. This organization continued through the reconstruction period with but little modification.

ACCOUNTING FOR MATERIALS USED IN OCCUPATIONAL THERAPY

In the fall of 1918 an inclination became evident among the disabled patients to expend their time in occupational work which had no particular value in preference to the more advantageous courses in education, and to make articles either for keepsakes, for gifts to friends, or to sell for profit. This state of affairs was one of the bases for criticism of occupational therapy



FIG. 11.—Occupational therapy—handcraft room

and led to reports pointing out the necessity for confining ward occupations to those who were unable to go to shops and classrooms and for discouraging the making of baskets, bead chains, trays, and similar articles for sale.¹⁰

In an effort to confine these activities to the proper and most advantageous channels instructions were issued in October, 1918, governing the procurement of and accountability for the materials used in occupational therapy as follows:¹⁰ Ordinarily raw materials were to be procured and expended much as other articles of medical supply. Such completed articles as were of use in the operation of the hospital were to be taken up on the property account; those of no use to the hospital and of no salable value were not to be taken up. Materials for articles which would be of no utility to the hospital, but would have a salable value, were to be purchased from the hospital fund and



FIG. 12.—Handicrafts for convalescents

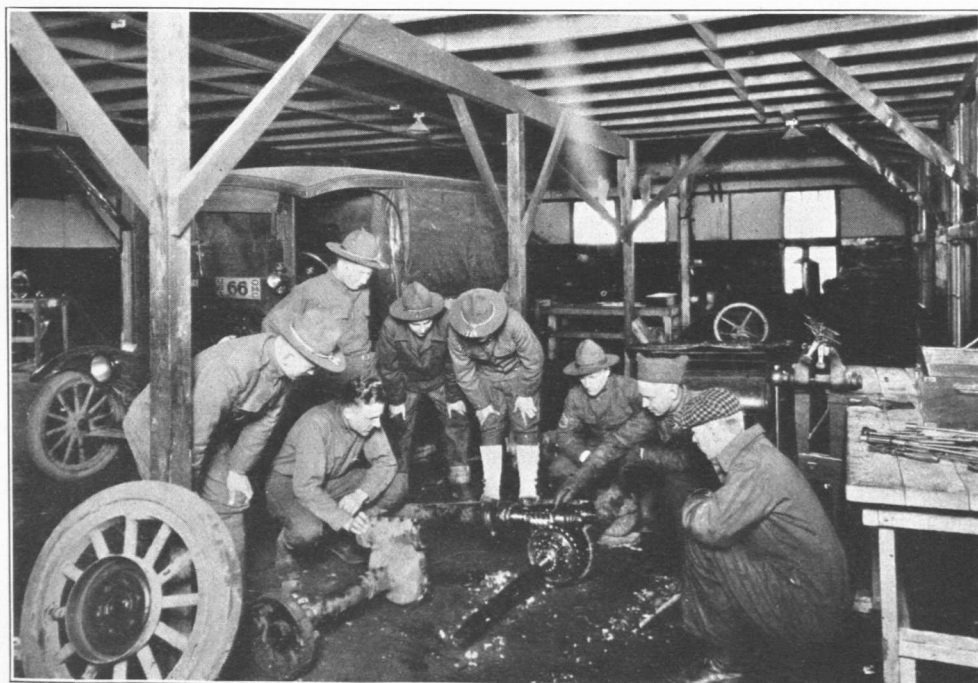


FIG. 13.—Instruction in automobile mechanics

were to be carried as "durable property" of this fund until transformed into completed articles. The finished product was then likewise to be carried until disposed of, usually by sale. The gross proceeds of sale were to be debited to the hospital fund, and any profit could be distributed pro rata among the patients engaged in their fabrication. In special cases the patient who made the article could dispose of it at his pleasure, otherwise than by sale.

An agency for the sale of the articles manufactured in all military hospitals that were of no use to the hospitals was maintained in Washington, D. C., for a time, but this later became the agency for Walter Reed General Hospital

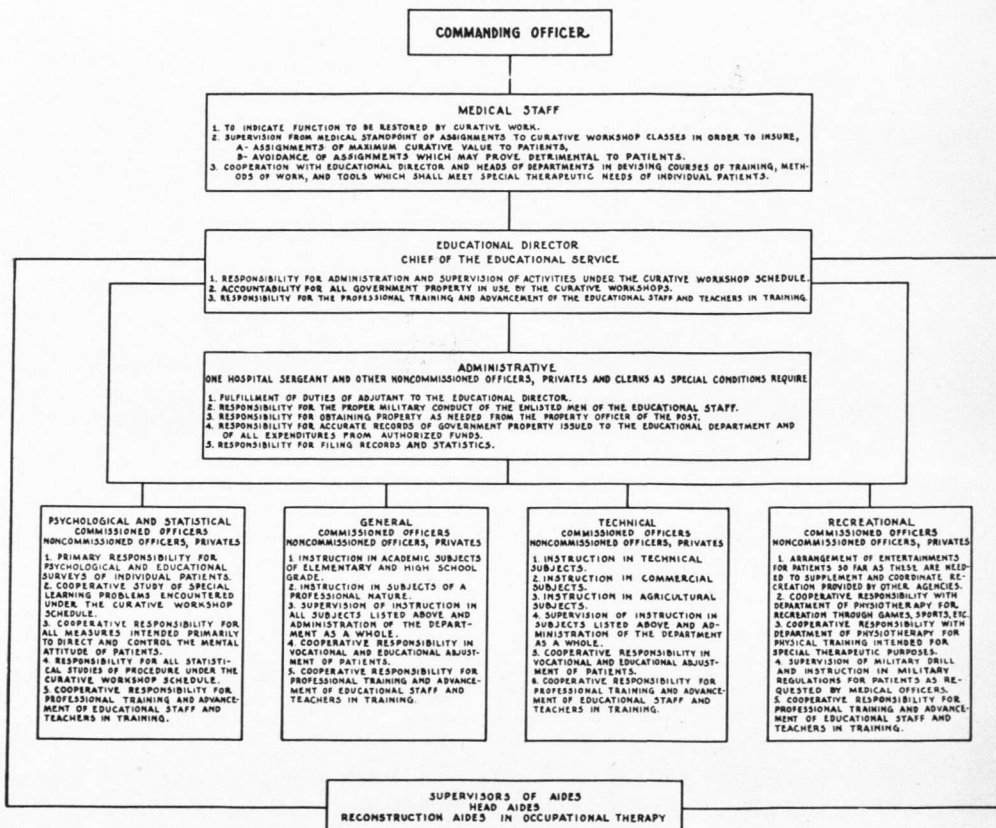


CHART II.—Organization of educational service in United States Army hospitals functioning in physical reconstruction

alone, and other hospitals were directed to dispose of their products through the post exchanges or other local agencies.¹⁰

These regulations caused some dissatisfaction among the patients, as in the main they desired the manufactured articles for such disposal as they saw fit, and led to the donation of materials from civilian sources to individuals and the purchase of materials by patients in order that the restrictions imposed need not apply. These conditions led to the following further instructions:¹⁰

(1) The purchase of raw materials was to be made only from the hospital fund.^b

^b This does not refer to requisitions for materials.—Ed.

(2) Purchase of raw material by individuals was not expected or required, and the acceptance by individuals of donations of material to be fabricated into articles for sale was to be prohibited. Donations to common stock or to individuals for fabrication for gifts or personal keepsakes, was to be permitted. (3) Sales of finished articles by individuals were not to be permitted. The proceeds of all sales were to be taken up as accruing to the hospital fund.

TYPES OF WORK PROVIDED IN FALL OF 1918

The following ward occupations and courses in the curative workshop schedule were being taught in the fall of 1918:^{11,12}

WARD OCCUPATIONS

(a) *Handicrafts*.—Basketry, bead work, bookbinding, book-end making, block printing, carving, chair caning, carpentry, colonial-mat making, designing, knitting, knotting, leather work, needlework, novelty box work, pottery making, picture framing, rug making, rake knitting, slipper making, string work, toy making, stenciling, water-color painting, weaving, and whittling.

(b) *Other work*.—Arithmetic, bookkeeping, business English, English, higher mathematics, history, mechanical drawing, penmanship, reading, science, shorthand, spelling, and typewriting.

CURATIVE WORKSHOP SCHEDULE

(a) *Academic*.—Arithmetic, civil-service subjects, English, English for foreigners, geography, history, mathematics, higher mathematics, penmanship, reading, science, and spelling.

(b) *Commercial*.—Bookkeeping, banking, insurance, accounting, correspondence, commercial law, stenography, and typewriting.

(c) *Technical, etc.*—Automobile driving, automobile mechanics, automobile repair, abattoir work, animal breeding, agriculture, applied art and design, barbering, basket making, building trades, blacksmithing, box making, bookbinding, cabinetwork, cartooning, chair caning, concrete working, curative walks, decorating, drawing, mechanical drafting, electrical work, farm management, furniture repairing and factory work, gardening, hospital duty, jewelry making, light work (road grading, etc.), linotyping, laundry work, locksmithing, leather working, machinist, general mechanic, mechanical engineering, metal working, motion-picture operating, monotyping, oxyacetylene welding, paintbrush making, painting, photography, piano tuning, poultry raising, physical exercises, printing, picture framing, planing-mill work (including sash, door, and interior trim), plumbing, pipe fitting, making orthopedic apparatus, radio operating, radio electrician, rug weaving, recreation (for normal and psychopathic), saddlery, sign painting, shoemaking, shoe repairing, tinsmithing, toy making, telegraphy, tractor repairing, tractor driving, tailoring, vulcanizing, hand and machine weaving, wood finishing and veneering, woolen mill work, and upholstering,

IN GENERAL HOSPITALS

The following account of the work in occupational therapy as it had developed by the close of the year 1918 at Walter Reed General Hospital is given, because this hospital enjoyed unusual advantages as to completeness of equipment, personnel, etc.

AT WALTER REED GENERAL HOSPITAL¹³

ORGANIZATION

The department of occupational therapy was divided into five sections—administrative, psychological and statistical, general or academic, technical, and recreational. The department acted as a training and demonstration



FIG. 14.—Patients' class in wireless telegraphy



FIG. 15.—Patients' art class



FIG. 16.—Patients learning to use left hand in writing

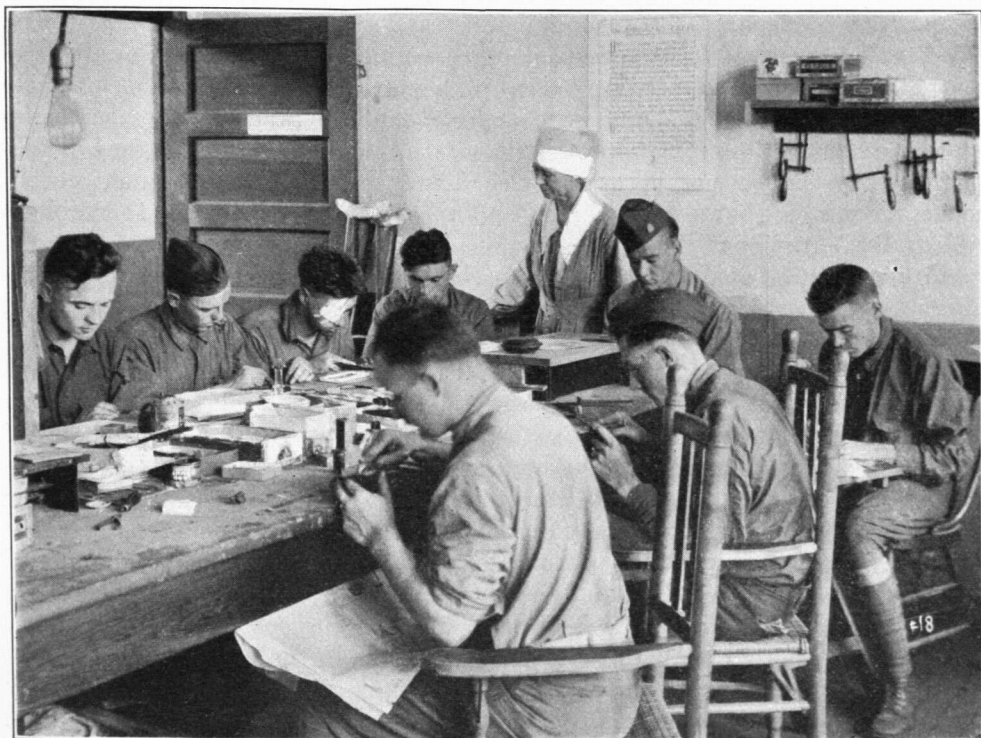


FIG. 17.—Patients working in jewelry class

school for other hospitals and an experimental laboratory for trying out methods of teaching, outlines of subject matter, types of equipment, and the selection and training of personnel.

ADMINISTRATIVE SECTION

The administrative section performed the duties of a record and property office. This required a large staff of clerks because of the rapidity of the growth of the department, the large "turnover" of patients, and the compilation of reports and data for the Surgeon General's Office.

PSYCHOLOGICAL AND STATISTICAL SECTION

The psychological and statistical section was primarily responsible for the psychological and educational surveys of individual patients. It made an intensive study of the problems encountered under the curative workshop schedule, the adaptation of curative methods to particular patients and specific disabilities, the application of trade tests and vocational guidance, and the measuring of intelligence by approved methods. The department was very successful in measuring the increase and strength of the movement of ankylosed joints and stump limbs. In detail the work performed comprised:¹³ (1) Psychological and educational surveys—interviews, psychological examinations, and records of personal, social, educational, and vocational history; these furnished guidance in assigning the patient to appropriate educational work, in making special adjustments in assignments to attain particular curative or functional results, and in helping to make a judicious selection of vocation. Intelligence ratings from group examinations or from individual examinations—these revealed cases of low-grade mentality or mental defect and special cases of maladjustment. (2) Psychological service for medical officers—mental ratings and analyses of special cases referred by ward surgeons. (3) Trade tests and vocational surveys—surveys preliminary to assignment to a special kind of training or to a particular state in a course of training, reports on mental and vocational fitness for full military duty, special service, limited service, domestic service, development battalion, surgeon's certificate of disability, and vocational placement. (4) Problems of learning—studies of the most economical and successful methods of learning, qualitative mental analysis, studies of special mental abilities and disabilities, the diagnosis and correction of cases of unsatisfactory progress in educational work, detailed examination of learning to write with the left hand and of learning type-writing. (5) The measurement of the amplitude of voluntary movements. These measurements serve the twofold purpose of encouraging and inspiring the patient by demonstrating to him in objective fashion that he was really improving and of informing the surgeon and physiotherapist regarding the rate and locus of improvement. (6) Mental attitude and morale. No single factor exerted a more powerful influence upon the patient's convalescence and subsequent rehabilitation than the mental attitude of the patient himself. The patient who had abandoned hope and indulged in self-commiseration and gloomy forebodings reached a condition which thwarted the best efforts of the surgeon and the educator. Lethargy was the inevitable result, and experience in the military hospitals of our allies had shown that so long as despondency, pessimism, and instability persisted the case was utterly hopeless. On the other hand, a cheerful optimism

on the part of the patient, a spirit of self-reliance and determination to cooperate, were so vitally important as to be indispensable.

Meetings of the staff and patients were held once a week in the Red Cross House or in the post auditorium. The purpose of these meetings was to present to the patients the advantages of taking work with the department of occupational therapy. The presence of officers from the Surgeon General's Office, demonstrations by the different departments, and talks on opportunities both in the hospital and outside made these meetings of great significance to many of the men.

GENERAL OR ACADEMIC SECTION

The academic or general department offered subjects from the most elementary grade through high-school grades. The department was particularly successful in reaching large numbers of patients who had not had the advantages of school training and who were desirous of taking courses which required some academic background.

TECHNICAL SECTION

The technical program comprised a wide variety of subjects and offered valuable instruction to the men who were mechanically inclined. The automobile department early seized upon the idea of doing practical work repairing cars. This gave the patients opportunity to put in practice what they had learned in class discussions. The drafting section was particularly successful in arousing the interest of the men, and gratifying results were obtained. Both farm and greenhouse work proved to be profitable. The woodworking department, in addition to its curative work, did a great deal of post repair work and made possible many conveniences in the shops. The rug-weaving section constantly appealed to patients, and many new types of curative exercises were developed. The jewelry section interested the men, and especially fine work was produced. Modeling developed the artistic temperaments of several men and provided them with a pleasing occupation while in the hospital.

RECREATIONAL SECTION

The recreational department handled the formal exercises and play hours of the patients fairly satisfactorily. At the beginning the work was severely handicapped by a lack of equipment and the lack of a permanent commissioned officer to supervise it; however, with the arrival of three or four instructors, the work was subdivided so that specialization was made possible, and a great deal of ward work was carried out. One instructor was able to devote most of his time to the amputation cases. Cooperation with the orthopedic section made this work more profitable. One of the large rooms was turned over to the recreational department to be used as a gymnasium. In addition to indoor sports, classes in dancing were organized for the men. The department closely cooperated with the department of physiotherapy and the American Red Cross.

BUILDINGS AND EQUIPMENT

Five new curative occupational buildings, erected southwest of the American Red Cross Building, were occupied by the department. These buildings, 24 by 144 feet, constructed of stuccoed hollow tile, were modern in every way,

well lighted, well ventilated, pleasant, and with interior arrangements and equipment planned to make them places where men could find health, strength, knowledge, and pleasure in constructive work. These buildings were utilized as follows: Buildings 93 and 94 contained (1) the school and administration offices; (2) the psychological laboratory (here were made measurements and recordings of the daily increase in movement in injured or disabled hands, arms, and legs, and the curative occupational and vocational needs of individual patients were analyzed); (3) the commercial department (instruction was offered in touch typewriting, shorthand, and stenotypy); (4) the academic department (instruction was given in elementary, secondary, and advanced academic and civil service subjects; the courses in this department offered excellent opportunities for mental occupations and the chance for reviewing forgotten studies or acquiring new ones); (5) the library (a constantly growing collection of scientific and reference books, current periodicals, and journals of the various trades, occupations, or professions). Building 95 contained (1) the electrical department (instruction was offered in electrical work, including Morse and radiotelegraphy, motor and general repairing, wiring, testing, etc.); (2) the engineering and drafting department (courses in elementary and advanced mechanical, architectural, and topographical drafting, tracing, and blue printing); (3) office and exhibition rooms of the ward occupation department. Building 96 contained the machine shop, where instruction in machine shop practice was given, and the cinematograph department, in which instruction was given in motion-picture machine operating, repair, and inspection. In building 97 there was the laboratory for orthopedic appliances. Here orthopedic appliances were manufactured and fitted, and instruction was given in their uses. Building 98 had (1) the woodworking department, where instruction was given in practical woodworking; (2) the oriental rug department (in textile weaving and designing, the special devices used were adapted particularly to the curative needs of the patient). An additional building contained (1) the printing and linotype department, where instruction was offered in hand composition and linotype operating, proof reading, and presswork; (2) the jewelry and metal department, wherein training in finer handicrafts, stone setting, jewelry making, and repair was given; (3) photography department (courses were given in commercial photography, developing, printing, and motion-picture film developing and repair).

AIDES

The work of the aides at Walter Reed General Hospital started February 15, 1918. The first work consisted of knitting colored wool squares for blankets and some machine knitting. The men, for the most part, were bed patients and welcomed the opportunity to do something. Gradually the work spread through the different wards as the need of it became evident, facilities were made available, and the work was systematized and organized.

The following activities over which the aides had supervision were carried on in the wards: Chair caning, cardboard construction work, woodwork, block printing, rush seating, brush making, bookbinding, modeling, rug making, stenciling, mop making, designing post cards, plasticine modeling, drawing,

leather work, hand knitting, rake knitting, frame knitting, machine knitting, weaving, basketry, bead work, making colonial mats, netting, cord work, crocheting, and embroidery.

To train the aides adequately for their work and to secure personnel, a school for reconstruction aides was started in 1918. It was postponed for a time, due to the influenza epidemic, but was reopened as soon as this became less serious. The course of training consisted of practical work with the patients under the supervision of experienced aides, and of lectures of both a general and professional nature. The school was discontinued soon after the signing of the armistice.

There follows a few of the types of correlation and coordination in the educational and occupational service:

WITHIN THE HOSPITAL

Relation of educational service:

1. To the commanding officer or adjutant in all lines of activity, buildings, facilities, and policies.
2. To the medical and surgical services with regard to the assignment and progress of patients.
3. To the physiotherapy service with regard to physical training.
4. To the commanding officer, medical detachment, in regard to furloughs, records, and discipline of enlisted instructors.
5. To the Red Cross and chaplains in regard to the recreation of patients.
6. To the post property officer in regard to the construction and repair of property in the curative workshop.
7. To post mess officer in regard to the production of farm and greenhouse products.
8. To the quartermaster for supplies and repair work.
9. To the laboratory service and to the section of Roentgenology in regard to photographic work.
10. To the limited service board, involving recommendations and vocational ratings of patients assigned to domestic duty.
11. To the surgeon's certificate of disability board in regard to the discharge of patients from the service.
12. To chaplains and various officers in maintaining morale.
13. To the post and to the division of reconstruction, Surgeon General's Office, in the professional training of educational directors, instructors, and reconstruction aides.

OUTSIDE ACTIVITIES

Relation of educational service:

1. To the Federal Vocational Board for educational histories and recommendations for further training of soldiers discharged from the Army.
2. To the personnel division and to development battalions for ratings on men for special lines of work in limited service.
3. To the Civil Service Department of the Government and private corporations and individuals in response to requests for qualifications of discharged men for positions.

FUNCTIONAL TREATMENT FOR ORTHOPEDIC CASES¹⁴

In filling out the medical officer's prescription blank (Form 2) for orthopedic patients, the ward surgeon was asked to check one or more of seven special types of functional treatment (abduction, adduction, flexion, extension, pronation, supination, and circumduction), together with the parts of the body to which he wished such treatment applied. Curative workshops, classrooms,

and laboratories were the places where the medical officers' prescriptions were "filled." The instructors in the several branches followed the directions as accurately as the drug clerk with this difference—the medical officers did not prescribe the exact compound, but rather stated the nature of the illness and defined the direction and limitation of the curative service work. Upon the instructor there fell, therefore, a great responsibility—namely, to organize his work around a therapeutic idea based upon the prescription method of approach to the problem and so developed under him as actually to give functional treatment.

DEFINITIONS AND EXERCISES

To furnish a basis for the accurate interpretation of prescriptions for functional treatment, there had been listed careful nontechnical definitions and descriptions of the types of movement required to fill each of the 43 prescriptions made possible by the lists on the back of Form 2. The definitions had been arranged under the types of treatment as main heads, with the names of the joints to which treatment was to be applied as subheads. Flexion of the knee, for example, was found described in the section headed "flexion" under the subheading "knee."

It should be noted that three types of treatment—namely, eversion, inversion, and rotation—while not specifically included in the list of treatments, were intended to be embraced under other types of treatment there specified. Eversion was included under "abduction of the ankle," inversion under "adduction of the ankle," rotation of the humerus under "circumduction of the shoulder," and rotation of the hip under "circumduction of the hip." Rotation of the trunk had been omitted for the reason that in the curative workshop treatment, it was practically impossible to distinguish that type of treatment from circumduction of the back. Prescriptions for treatment of the neck had also been omitted, since practically all the muscular movements which such treatment demanded were exceedingly ill-defined, if not entirely lacking, in the curative workshop activities.

As a suggestion of the types of work which might prove of service in providing the treatment called for by orthopedic prescriptions, there had been added after each definition one or more examples of curative workshop activities which involved the movements there described. These examples had been chosen mainly from woodworking, metal working, and agriculture, though a few had been drawn from typewriting, pottery making, and one or two other occupations. The suggested operations had been classified in two groups. The first included types of work which necessarily involved for their proper performance the use of the muscles under consideration, and the second included types of work which involved the use of the special muscles for their most efficient performance, but which might be accomplished, though to less advantage, through the use of other sets of muscles. The second type of work was of slight value in cases where the patient was inclined to avoid by every possible means the use of the muscles needing treatment. The first type, on the other hand, should be used with caution, lest the patient injure himself by too energetic or too continuous exercise of an affected joint.

It was not intended that the examples given should be more than suggestions of the types of work which should be undertaken in response to medical officers' prescriptions. For each patient the instructor should lay out a course of work leading by gradual stages to the attainment of the functional results desired by the medical officer and including such special activities as were necessary to reach these results. That most of these activities might be chosen with equal value from widely varied workshop occupations was shown by the examples given below; so, even while retaining as his fundamental aim the functional cure of the patient, the instructor might take into account also the patient's psychological, vocational, and educational needs. From both points of view the assignment of workshop occupations to the patient must be a strictly individual matter.

The pressing need in the treatment of orthopedic cases by occupational therapy was for a detailed scientific study of such workshop operations as those suggested below to determine the exact muscular movements involved in these operations and the functional results which might be expected from their practice. Such a study would make possible at least a partial systematization of the treatments which were suggested in necessarily disorganized fashion. It was for the purpose of affording a definite basis for study along these lines by making possible an accurate interpretation of prescriptions that the following definitions were presented:

Abduction (motion away from the axis of the body; turning outward)

Thumb: Motion of the thumb away from the median line of the hand in the plane of the palm, as in the spreading of thumb and fingers.

Exercises: (1) Glass setting; potting plants, typewriting (right thumb), piano playing, hand forming on potter's wheel, etc.; (2) use of miter box, holding broad piece in position (left thumb), etc.

Fingers: Motion of the fingers away from the median line of the hand in the plane of the palm, as in the spreading of the fingers.

Exercises: (1) Use of special large handle top on screw driver (right hand), use of special large plane knob (left hand), typewriting, piano playing, use of ball glove (left hand), etc.; (2) glass setting, firming soil in flats (greenhouse work), etc.

Wrist: Motion of the hand, bending at the wrist in the plane of the palm in the direction opposite the thumb.

Exercises: Hammering, use of monkey and Stillson wrench in horizontal position, use of large auger, use of flat wrenches, piano playing; etc.

Elbow: No abduction possible.

Shoulder: The movement of the humerus produced by raising the arm straight sideways, to or above shoulder height.

Exercises: Turning crank of large radius, as on grindstone, portable crane, etc. use of pulley shift levers arranged to make this motion necessary or most convenient, pitching hay, practice of wigwag signaling, etc.

Back: No abduction possible.

Toes: Abduction negligible.

Mid-tarsus: No abduction possible.

Ankle (abduction of foot): Turning the foot outward and upward at the ankle; position similar to that of foot of person with weak ankles in skating, foot resting on inner side.

Exercises: (1) Use of specially tipped pedals on grindstone, foot-power lathe, jig saw, etc., operation of loom with heel fixed so that turning of foot is necessary for working different pedals, use of special pedals on hayrake or tedder, etc.; (2) work on uneven ground, as in plowing or on a hillside, etc.

Knee: No abduction possible.

Hip: Motion of the hip produced by raising leg straight toward side, without rotation

Exercises: (1) Driving disk harrow or mowing machine, riding horseback, etc.; (2) straddling, as in working on long piece in lathe, etc.

Adduction (motion toward center of the body; turning inward)

Thumb: Motion of the thumb from the position of extreme abduction toward the median line of the hand, across the palm.

Exercises: (1) Milking, etc.; (2) use of cabinet scraper (adjustment), etc.

Fingers: Motion of the fingers from the positions of extreme abduction toward the median line of the hand in plane of the palm.

Exercises: Use of special small hand top on screw driver (right hand), use of special small plane knob (left hand), kneading soil for greenhouse use, etc.

Wrist: Motion of the hand, bending at the wrist in the plane of the palm toward the side of the thumb.

Exercises: Hammering, use of monkey or Stillson wrench in horizontal position, use of large auger, use of flat wrenches, piano playing, etc.

Elbow: The movement of the humerus produced by bringing the arm from a position of abduction down to or beyond the median line of the body, in the line of the body.

Exercises: Turning crank or large radius, as on grindstone, portable crane, etc., use of pulley shift levers arranged to make this motion necessary or most convenient, pitching hay, use of scythe, practice of wigwag signaling, etc.

Back: No adduction possible.

Toes: Adduction negligible.

Mid-tarsus: No adduction possible.

Ankle (adduction of foot): Turning the foot inward and upward at the ankle, position similar to that of foot of person with weak ankles in skating, foot resting on outer side.

Exercises: (1) Use of specially tipped pedals on grindstone, foot-power lathe, jig saw, etc., operation of loom with heel fixed so that turning of foot is necessary for working different pedals, use of special pedals on hayrake or tedder, etc., (2) work on uneven ground, as in plowing or on a hillside, etc.

Knee: No adduction possible.

Hip: Motion of the hip produced by moving toward and beyond the median line of the body, the other leg being so displaced by adduction as to allow motion of the leg under treatment in a plane parallel to that of the front of the body. (Example: The patient lies on a plane surface on the side of the leg under treatment, with the other leg held by second person in a position of abduction. He then raises the affected leg in line with the body, with the knee straight and without rotation.)

Exercises: Planting by hand, and covering with the foot, etc.

Flexion (the bending of a joint so that the parts which it connects are approximated)

Thumb: The natural bending of the thumb at its joints, as in "making a fist," with the thumb covered by the fingers.

Exercises: Grasping round objects, such as levers, tools, materials, etc., use of hand dibble and other garden tools, carrying objects by means of handles, specially adapted if necessary, etc.

Fingers: The natural bending of the fingers at the joints, as in "making a fist."

Exercises: Grasping round objects, such as levers, tools, materials, etc., use of hand dibble and other garden tools, carrying objects by means of handles, specially adapted if necessary, etc.

Wrist: The bending of the wrist so that the palm approaches the inner side of the arm.

Exercises: (1) Use of woodcarving tools, working in "high relief," use of sickle, etc.; (2) driving horse, sowing seeds broadcast, use of hand pump with vertical piston and horizontal handles, etc.

Elbow: The motion of the elbow produced by bending the forearm toward the upper arm till the hand touches the shoulder.

Exercises: Hammering, planing, filing, shoveling, hoeing, use of long-handled rake, use of spray pump, etc.

Shoulder: The movement of the humerus produced by raising the arm straight forward and upward from the natural position by the side.

Exercises: Planing, use of ax or sledge hammer, operation of overhead lever as on drill press, use of overhead rope shipper in machine shop, hoeing, use of mattock, threshing by hand, etc.

Back:

Forward bending—bending the trunk at the hips, from vertical to horizontal, with trunk kept straight.

Exercises: Planing, sawing, hoeing, cultivating by hand, practically all work below waist level.

Side bending—bending the trunk at the hips, in the plane of the body, from vertical to right or left.

Exercises: (1) Use of scythe, etc.; (2) pitching hay, guiding plow in rough land, etc.

Toes: Bending the toes toward the sole of the foot, as in "making a fist" with the foot.

Exercises: Pushing heavily loaded wheelbarrow in soft ground, spading (pushing spade into ground), etc.

Midtarsus: Bending downward the fore part of the foot (from the middle of the instep to the toes), as in "making a fist" with the foot.

Exercises: Pushing heavily loaded wheelbarrow in soft ground, spading (pushing spade into ground), etc.

Ankle: Motion of the foot (bending at the ankle) straight upward in the line of the leg in such manner that the angle between the upper side of the foot and the shin becomes acute.

Exercises: (1) use of foot-power machines with treadles or specially adapted pedals, etc.; (2) planing (for right foot), pushing heavily loaded wheelbarrow, etc.

Knee: Bending the knee from the straight position until the heel touches the buttock.

Exercises: (1) Laying floors, use of adapted foot-power machinery, bicycle riding, etc.; (2) planting, transplanting, and thinning; weeding root crops, etc.

Hip: Motion of the hip produced by raising the leg (knee bent) until the knee touches the chest.

Exercises: (1) Use of adapted foot-power machinery, operation of horserake, etc.; (2) stooping and sitting on heels to work at low level, as in laying floors, etc.

Extension (the bending of a joint in such manner as to diminish or extinguish the angle formed by flexion)

Thumb: Forcible straightening and bending back of the thumb from the position of grasping.

Exercises: Glass setting, hand forming on potter's wheel, piano playing, etc., holding broad piece in miter box, left thumb, etc.

Fingers: Forcible straightening and bending back of the fingers from the positions of grasping.

Exercises: Use of cabinet scraper, sharpening flat-bladed tools, glass setting, pulling on object too large to grasp, such as drill-press lever with special handle, etc.

Wrist: The movements of flexion reversed and carried as far as possible in the opposite direction.

Exercises: (1) Filing, use of wood-carving tools, working in "high relief," pitching hay, use of spade, etc.; (2) feeding material to circular saw, band saw, jig saw, planer, use of trowel, etc.

Elbow: Forcible straightening of the arm from the position of flexion.

Exercises: Planing, sawing, hammering, filing, shoveling, hoeing, operation of spray pump, carrying heavy objects by handles, etc.

Shoulder: The movement of the humerus produced by bringing the arm from the vertical position above the head forcibly straight forward, downward, and backward.

Exercises: Hammering above head, use of sledge hammer or ax, use of two-hand crosscut saw, operation of overhead lever, as on drill press, use of overhead rope shipper in machine shop, use of Norcross or wheel hoe, etc.

Back: Bending of the trunk from the position of forward bending to the vertical and backward.

Exercises: Planing, sawing, hammering overhead, sawing overhead, hoeing, pitching hay, etc.

Toes: Bending the toes toward the upper side of the foot.

Exercises: (1) Work overhead requiring standing on tiptoe, use of special pedals as on a grindstone, jig saw, etc., requiring pressure from toes alone, etc.; (2) thinning, transplanting, weeding, tying tomatoes, picking beans, etc.

Midtarsus: Bending upward the fore part of the foot (from the middle of the instep to the toes).

Exercises: (1) Work overhead requiring standing on tiptoe, use of special pedals as on grindstone, jig saw, etc., requiring pressure from toes alone, etc.; (2) thinning, transplanting, weeding, tying tomatoes, picking beans, etc.

Ankle: Motion of the foot (bending at the ankle) straight downward in the line of the leg, as in standing on tiptoe.

Exercises: (1) Work overhead, requiring standing on tiptoe, use of foot-power machines, specially adapted if necessary, etc.; (2) walking down hill, as in wheeling barrow, etc.

Knee: Forcibly straightening the leg from the position of flexion.

Exercises: Use of foot-power mortising machine or grindstone, use of foot-power potter's wheel with disk drive, use of horseshoe.

Hip: Motion of the hip produced by forcibly bringing the leg into the line of the body and backward from the position of flexion.

Exercises: Work requiring standing and walking, use of foot-power machinery, pitching hay, use of scythe, forking manure, etc.

Pronation (the turning of the palm of the hand downward, applied exclusively to forearm and hand)

Wrist—elbow: Motion of the hand from position with the palm up to position with the palm down.

Exercises: (1) Use of screw driver or awl (counter-clockwise motion), use of wood-carving tools, etc.; (2) use of garden trowel, potting operation, use of shovel or spade, etc.

Supination (the turning of the palm of the hand upward, applied exclusively to forearm and hand)

Wrist—elbow: Motion of the hand from position with the palm down to position with the palm up.

Exercises: (1) Use of screw driver or awl (clockwise motion), use of wood-carving tools, etc.; (2) use of shovel or spade, etc.

Circumduction (the circular movement of a limb)

Thumb: Circular movement of the thumb about its normal axis.

Exercises: Typewriting, etc.

Fingers: Circular movement of the fingers about their normal axes.

Exercises: Typewriting, etc.

Wrist: Circular movement of the hand bending at the wrist about the axis of the forearm.

Exercises: Turning of small wheel, as on cross feed and carrier of lathe, use of hand drill, spraying inside greenhouse, etc.

Elbow: Circumduction negligible.

Shoulder (rotation of humerus): The movement of the humerus produced by rotating or twisting the arm, extended to the side at right angles to the body, from the extreme at which the elbow is down to the extreme at which it is up and reverse.

Exercises: Use of large screw driver, use of scythe, use of long-handled shovel, etc.

Back: Circular movement of the trunk about the vertical axis of the body.

Exercises: Use of scythe, etc., use of large tap wrench in horizontal position, use of large auger, pitching hay, etc.

Toes: Circumduction negligible.

Midtarsus: Circumduction negligible.

Ankle: Circular movement of the foot about its normal horizontal axis.

Exercises: (1) Operation of loom with heel fixed so that turning of foot is necessary for working different pedals, etc.; (2) following plow in rough ground.

Knee: Circumduction impossible.

Hip (rotation of hip): Movement of the hip produced by rotation of the leg in manner corresponding to rotation of upper arm to produce rotation of humerus.

Exercises: Use of large tap wrench in horizontal position, use of large auger, use of scythe, pitching hay, use of long-handled shovel, etc.

IN BASE HOSPITALS

The signing of the armistice necessitated the provision of many more hospital beds for reconstruction purposes than originally had been planned in order to care for the expedited return of the patients in overseas hospitals. When certain base hospitals were designated in December, 1918, to establish reconstruction services, the following letter of instructions was sent to each:¹⁰

1. An educational officer has been assigned to your hospital, as it has been designated to receive disabled soldiers from overseas. It is desired that everything possible shall be done to make these men happy and contented while under treatment and have them go back to civil life with the determination to profit by the opportunities which the Government is offering them with a view to their success in after life. The experience of the last 10 months in general hospitals has shown that an educational officer at the head of the curative mental and manual work department can do a great deal to keep up the morale of the men by seeing to it that they are either employed in profitable study or availing themselves of vocational training opportunities or that their recreation is intelligently directed.

* * * * *

3. As soon as possible a consultant, experienced in educational administration and familiar with the work as developed in the hospitals, will be sent to assist you, your medical staff, and the educational officer with the development of this work.

4. Experience has shown that the following types of work can be done, and the educational officer should devote himself to developing these groups with a view of interesting men in this and other work which may be done as curative measures and of value vocationally:

(a) Bedside work where men are confined to the bed or wards: Many men are interested in the minor craft work, and reconstruction aides, both men and women, are employed for this and any other work in the interest of this service. As soon as the condition of the patient will permit, the bedside and the ward work should be made the beginning of serious study, and the place where information is given as to a man's future opportunities under the Federal Board for Vocational Education and his rights under the war risk insurance act. All reconstruction aides and other members of the educational service should familiarize themselves along these lines and inform the men of their opportunities. In addition to this, the beginnings can be made in English for foreigners, training in citizenship, left-hand penmanship, and other training in the use of the left hand for men with right arm amputations, shop mathematics, shop sketching, use of the slide rule, typewriting, bookkeeping, and other trade extension work for men with some mechanical training and experience, vocational guidance for men who will return to the trades and commerce, and educational guidance for those who will go back to school and college.

(b) If space can be secured, classroom work can be done in typewriting, stenography, bookkeeping, penmanship, English, mathematics, drafting, and in other subjects. A minimum equipment for these lines of work is being sent to the hospital. The exact list of equipment is sent under separate cover. The war camp service of the American Library Association has agreed to send several hundred books for texts. Where adequate space can be secured, work can be done in telegraphy, printing, shoe repairing, engraving, jewelry work, and the theoretical work of automobile instruction. In the case of the latter it will be necessary to have one or more engines, rear axles, transmissions, magnetos, carburetors, starting and lighting systems, batteries, etc. (It is believed that these can be secured either by donation or by memorandum receipt from the reclamation section of the motor transport division.) If the camp utilities and other shops are suitably located or transportation can be secured, much profitable trade instruction and prevocational work can be obtained by cooperating with these departments. The following opportunities exist in some of the camps: Oxyacetylene welding, blacksmithing, shoe repairing, clothing renovation, barbering, carpentry, telephone and telegraph exchange, care of pumps, motors, generators, etc., in connection with the water and sewerage systems, and laboratory work in connection with auto work in other hospital departments.

In fact, the camp has practically all of the vocational opportunities found in the maintenance of a city of equal size, and the hospital assignment offers opportunity during convalescence for adjustments with the work-a-day world which the patient will reenter after discharge.

5. Representatives from the Federal Board for Vocational Education and the War Risk Insurance will cooperate with the educational officer in instructing his staff, so that they may give information to the disabled men.

6. Upon the educational officer devolves the responsibility of bringing together those educational, vocational, and social forces which are an essential part of the treatment given to hasten the cure and to promote a high standard of morale while the men are under treatment or awaiting their discharge. This officer must organize, subject to your approval, an educational service which will coordinate the volunteer agencies now working in the hospitals, develop interest in study and vocational opportunities and training useful in civil life, and select and train a personnel to handle educational service, inform patients, his associates, and all concerned of the various governmental agencies available and useful to discharged men.

* * * * *

FINANCIAL ASSISTANCE BY THE AMERICAN RED CROSS

Following the extension of reconstruction work to base hospitals, the service enlarged so rapidly that the authorized expenditures of money and supplies could not meet the immediate need.¹⁵ In this crisis the American Red Cross placed at the disposal of the department of education an emergency fund of \$200 per month for each reconstruction hospital, to be expended on the order of the chief educational officer of the hospital for supplies, equipment, or service which were needed immediately and not readily procurable from Army supplies or funds.¹⁵ Monthly reports of expenditures in detail were to be made to the Surgeon General. The situation was relieved to such an extent by May, 1919, that steps were taken for the discontinuance of the fund.¹⁶

THE RECONSTRUCTION SERVICE AS FINALLY DEVELOPED

Prior to July, 1919, the two component parts of the reconstruction service—the educational and the physiotherapy departments—had operated more or less independently in the reconstruction hospitals. The Surgeon General at that time, however, ordered that a chief of the section of physical reconstruction be appointed in each reconstruction hospital in order to coordi-

nate the work with other hospital activities.¹⁷ The sections of the reconstruction service now comprised psychological and statistical, recreational, general or academic, technical, and physiotherapy.

PSYCHOLOGICAL AND STATISTICAL SECTION

The duties of this section of the educational department were as follows:⁹ (1) Responsibility for psychological, social, educational, and vocational surveys of individual patients; (2) special service in connection with the problems of learning encountered in the curative workshop schedule; (3) cooperative



FIG. 18.—Instruction in automobile repairing

responsibility for all measures intended primarily to direct and control the mental attitude of patients; (4) responsibility for all statistical work connected with the curative workshop schedule; (5) such a service in connection with the training of the educational staff as might be needed.

The individual surveys required personal interviews to obtain the patient's personal and social history; an educational rating as a basis on which to plan reconstruction courses; an intelligence rating as a criterion of mental capacity for future training; a trade rating for future vocational reference; an analysis of mental attitude, interests, special abilities, and morale as a basis for estimating initiative and effort; and an analysis of the range and character of voluntary movement in disabled parts for use in the application of occupational therapy.¹⁸



FIG. 19.—An invalid instructor in oxyacetylene welding

The fundamental purpose of the diagnostic picture obtained was to allow the formulation of a constructive remedial program; the patient was to be shown what he could do and how he could do it and be helped to find a healthy, optimistic, and creative attitude toward life.

Social surveys showed that the main problems connected with the new patients concerned Government compensation, Government insurance, allotments, Liberty bonds, back pay, reconstruction work, furloughs, artificial limbs, recreation, information from home, and hospital regulations.¹⁸ The problems connected with those who were soon to be discharged concerned the family, social and financial status, reputation and industry, educational life, housekeeping standing, deterioration since the war, the attitude of parents toward the patient, the attitude of the man toward his community, marital complications, love affairs, preparation of the family for the type of patient's injury, need of supervision in the home, living accommodations, church or recreational opportunities, and opportunities for future training.

These problems were cared for by individual action or by reference to such agencies as the reconstruction department, American Red Cross, American Library Association, Federal Board for Vocational

Education, insurance officer, and ward surgeon. Five hundred and thirty-two such cases were handled in one week in one hospital.¹⁸ As an indicator of the value of the service from the treatment standpoint, 103 cases were referred during one month in the same hospital by ward surgeons.

The school and trade ratings showed a surprisingly low average, due to the previous coming out of trained men for special work, so that few of the higher classes were used in the ranks of combat troops.¹⁸ Such ratings were of value in estimating a man's qualifications for future employment, both for limited service and after discharge. They furnished information as to the amount and



FIG. 20.—Oxyacetylene welding as a vocation for men with arm amputations

type of previous experience and the degree of ability, skill, and judgment. In the trade test, ratings were given as novice, apprentice, journeyman, or expert; 30 trades were represented in one group of 119 patients rated, 32 in another group of 75, and 54 in a group of 156. Of 231 patients rated, 145 had had two or more years' experience.¹⁸

The occupational survey included the main occupation, years engaged, just what the worker did, name of firm employing, kind of business, department or branch, weekly wage, reasons for leaving, stability of employment, whether member of a union, second occupation, third occupation, Army occupation, Army experience, and patient's occupational preference, with reasons therefor.¹⁸ The general tendency was for the disabled soldier to pass through a

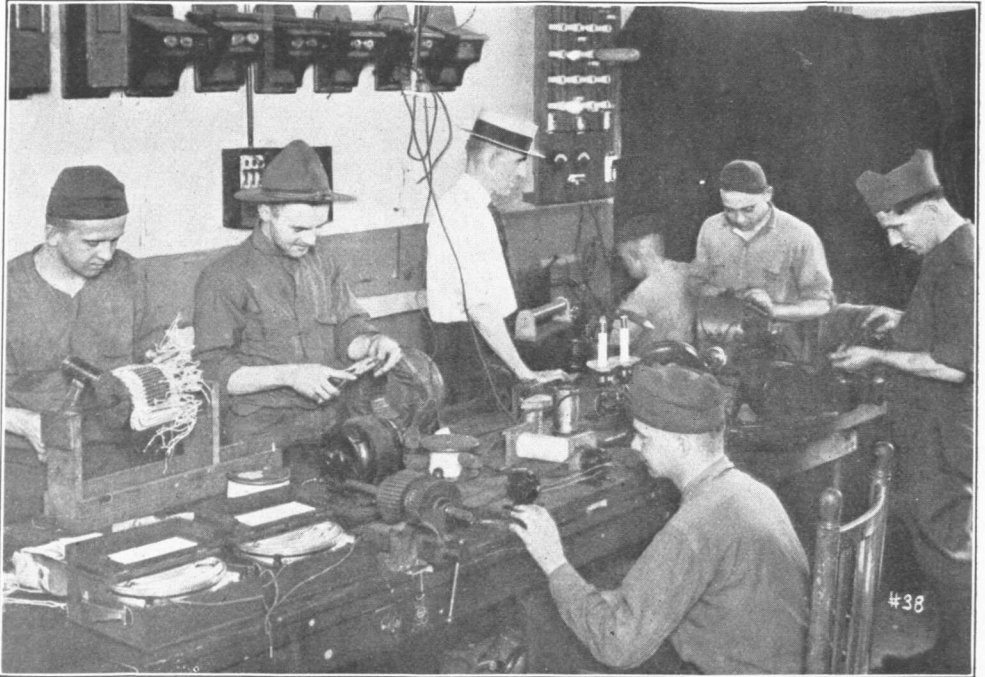


FIG. 21.—Instruction in electrical work

period of instability, with his preferences shifting from one occupation to another and almost any type of constructive activity making a strong appeal to his imagination.

The purposes of the tests were¹⁸ (a) to indicate to the disability board whether or not the man should be retained in service; (b) to indicate to the limited service board the branch of service or occupation to which he should be assigned; (c) to assist in making proper assignment in the curative workshop and to the stage at which training should begin; (d) to assist in vocational counsel and guidance; (e) for future use by the Federal Board for Vocational Education.

Certain classes of patients required special attention to direct and control their mental attitude.¹⁸ This was true to some extent of nearly all disabled



FIG. 22.—Linotype operating

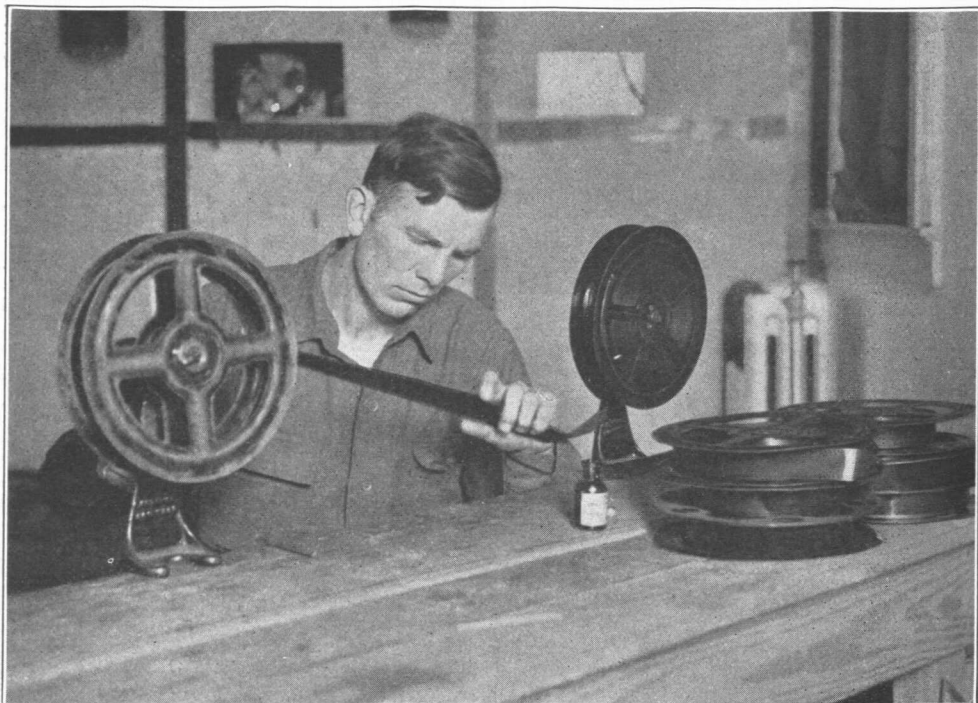


FIG. 23.—Motion-picture operating

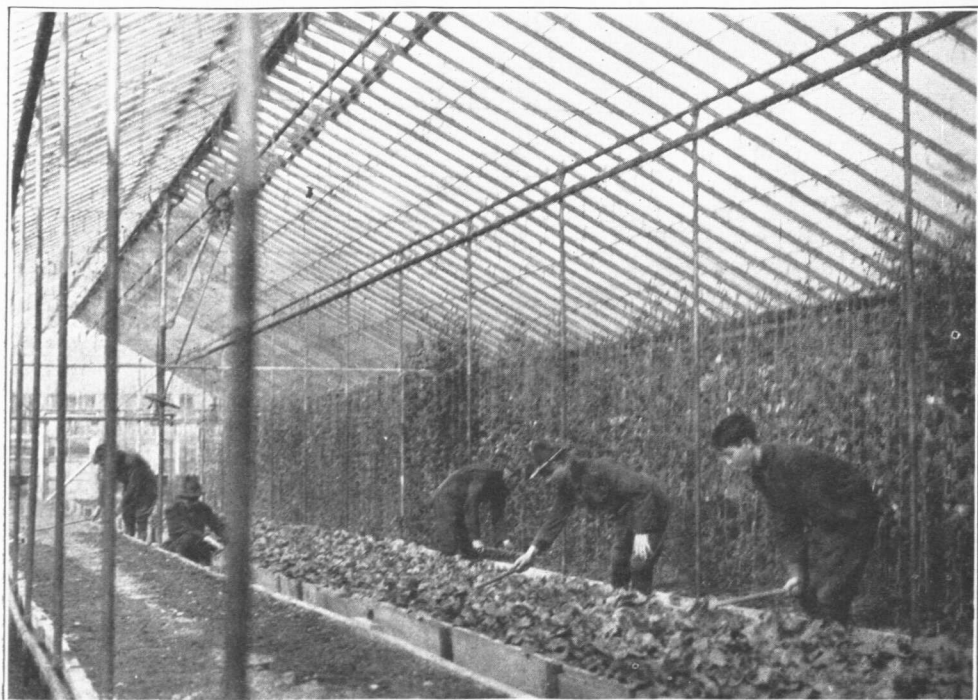


FIG. 24.—Work in the greenhouse



FIG. 25.—Woodworking shop



FIG. 26.—Shop for instruction in shoe repairing

men. The aides with their ward occupations served the purpose in the majority of cases, but men with amputations required special supervision, and particularly did those who had lost an arm.

One-armed instructors were employed to demonstrate the methods employed in making one arm perform the duties of two, as in the employment

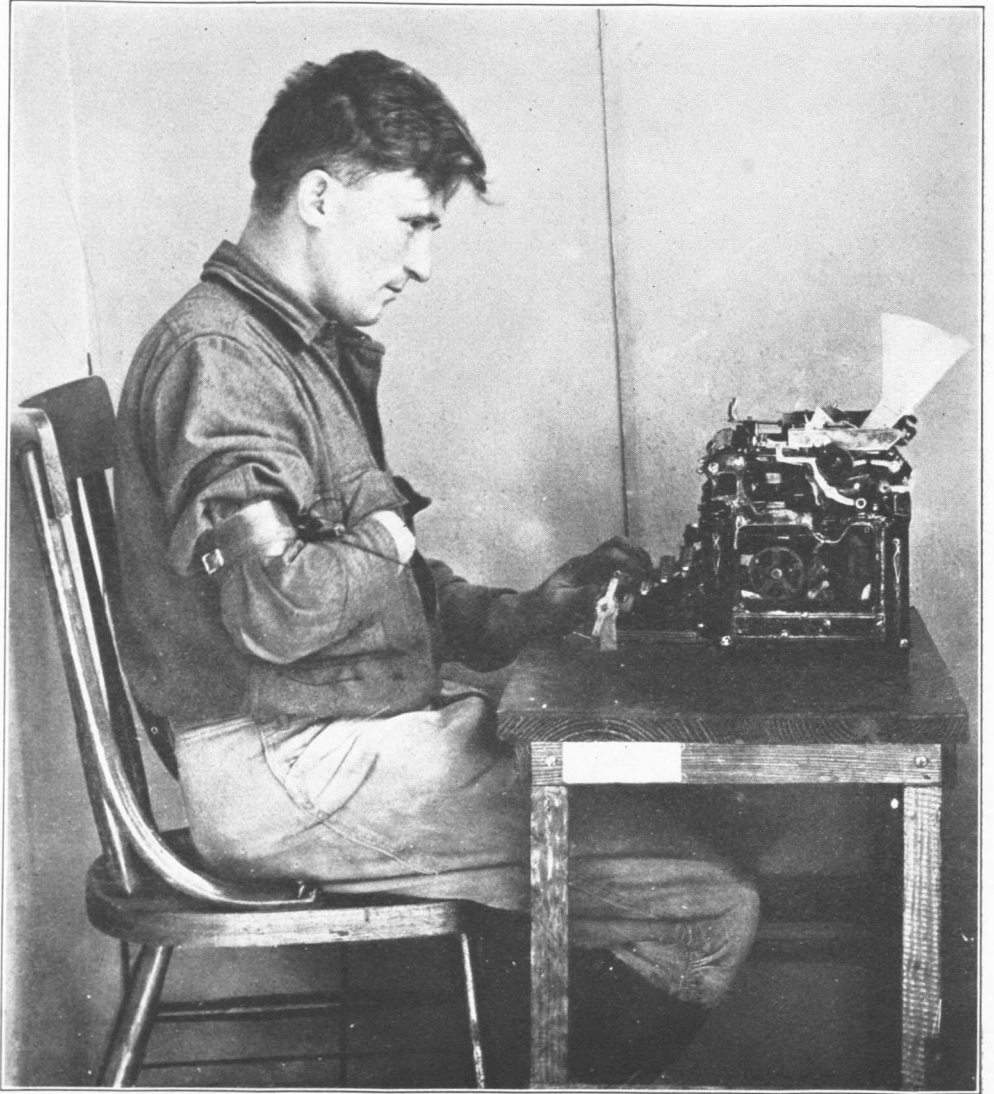


FIG. 27.—Commercial course—typewriting for hand amputation

of devices for tying shoes and neckties, putting on a collar, eating, rolling cigarettes with one hand, etc.¹⁸ It was the ability to do those little things that made the handicapped man independent in his home and led him to experiment with more difficult problems. In right-handed men who had lost the right arm, the left had to be taught to perform many minor duties, such as writing. Games had a particular psychological value in that they aided materially in building

up a mental background of self-confidence, self-respect, self-control, and social cooperation with others. It was remarkable how much of the inactivity of an artificial limb was due to habits which could easily be eliminated by a trained psychologist who was familiar with the general principles of motor coordination. An intensive study of all considerations bearing on the question of a possible change of occupation for 18 amputation cases (10 arm and 8 leg) resulted in the following opinion:¹⁸ Change of occupation desirable, 6; change not necessitated, 12. Of the latter, however, four desired a change in order to find occupations more to their liking.

Measuring and recording progress of cases under treatment, where practicable to do so, were of value to those in charge, and the visible demonstration

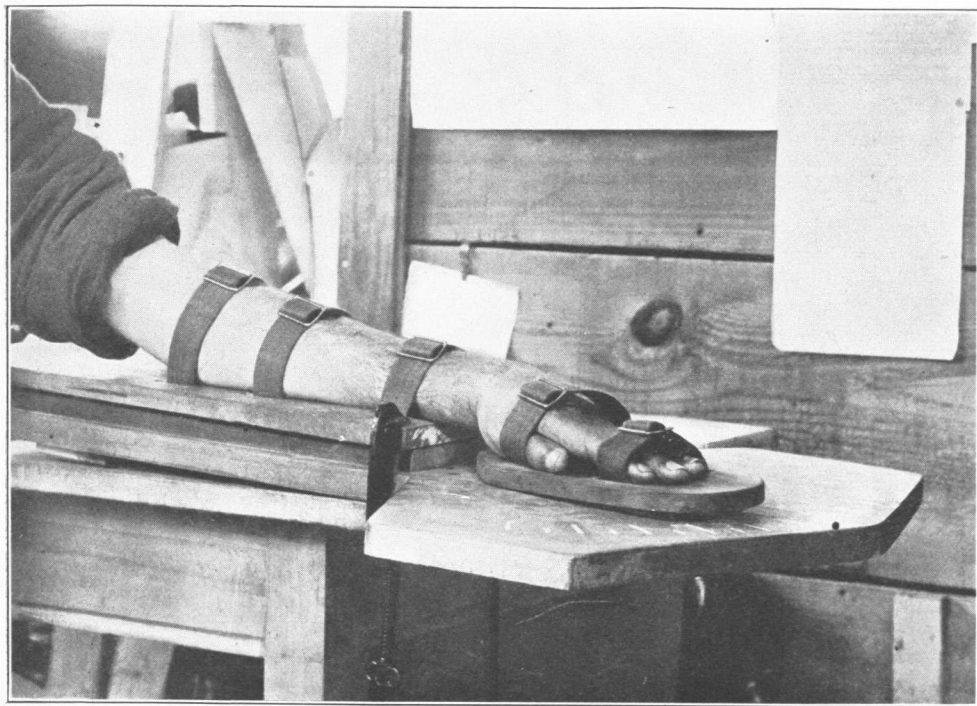


FIG. 28.—Measuring abduction and adduction of the wrist, psychological and statistical division

was of psychologic value to the patient by showing the rate of improvement and through competition with the others by ascertaining who could show the greatest improvement. Measurements of both strength and range of movement of joints furnished the bulk of this work.¹⁸ Some of the apparatus used are shown in Figures 28 to 30, inclusive.

RECREATIONAL SECTION

The recreational section of the educational department came into existence late in 1918.⁹ It was charged with the arrangement of entertainments for patients in so far as these were needed to supplement and coordinate recreation provided by other agencies; cooperative responsibility with the department of psysiotherapy for recreation through games, sports, etc.; cooperative respon-

sibility with the department of physiotherapy for physical training intended for special therapeutic purposes; and supervision of military drill and instruction in military regulations for patients as requested by medical officers.

The purposes of the recreational section were to induce in the individual patient a state of mind and in the institution a general spirit that facilitated recovery, to provide beneficial therapeutic exercise for all patients, to provide for the patients such diversion and training as would contribute to recovery and at the same time fit them for better service to the Army and society after recovery, and to maintain in the able-bodied personnel a spirit of cheerfulness and interest in the work in the institution.

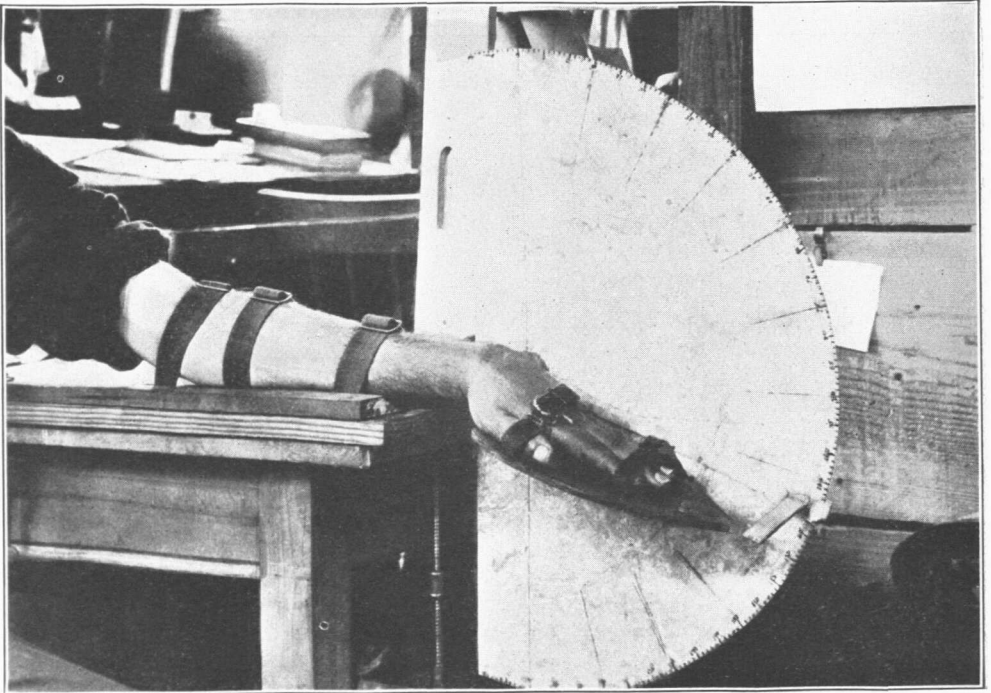


FIG. 29.—Measuring flexion and extension of the wrist, psychological and statistical division

The activities were divided into classes—those for which the American Red Cross and other welfare organizations through the American Red Cross were to be responsible and those to be conducted by the educational service.¹⁹

The American Red Cross was to be responsible for¹⁹ entertainment and recreation in convalescent houses and wards and for the able-bodied personnel, the purposes of which were to maintain, through the American Library Association, a library of technical works, approved fiction, current magazines, periodicals, newspapers, and library service; to organize, encourage, and conduct reading circles, debates, and story-telling hours; to provide training in amateur theatricals; to arrange for and equip bands and orchestras; to provide leadership for the development of singing, individually and in groups; to furnish, equip, and maintain a writing room; to furnish and maintain an equipment of indoor games, player piano, phonographs, rolls, and records; to

furnish stereoscopes and photographs of educational value; to present entertainments; or organize and supervise social functions; and to supply fruit, flowers, smoking materials, and refreshment. In addition, outdoor games were to be arranged for the able-bodied personnel. The supplemental services comprised arrangements for personal religious services and ministrations in wards at the request of individual patients.

The recreational functions of the department of education were the general supervision of all recreational activities in cooperation with the American Red Cross, the selection and supervision of approved games and sports to attain desired therapeutic results, the working out of special exercises for each of the larger groups represented in reconstruction work, in cooperation with other departments the provision for the editing and publishing of the hospital paper, and the training of the staff devoted to recreational work.

Recreational activities proved so popular in hospitals that it was sometimes necessary to curtail organizational programs in order to allow time for patients to participate in the educational work.¹⁹

GENERAL OR ACADEMIC SECTION

The general section comprised instructional agencies devoted to academic studies and related matters.⁹ These agencies ranged from the teaching of illiterates to read English, through the ordinary grade and high school subjects to preprofessional courses, and included the necessary reports, schedules, selection of textbooks, and organization and training of teaching personnel.

The occupational aides worked mainly under the general division, although portions of their work were subject to the supervision of each of the other divisions.

UNIT COURSES OF STUDY

The unit courses of study comprised one of the really constructive achievements of the educational service, those in the academic and commercial fields being particularly popular,²⁰ as each was complete in itself for the subdivision

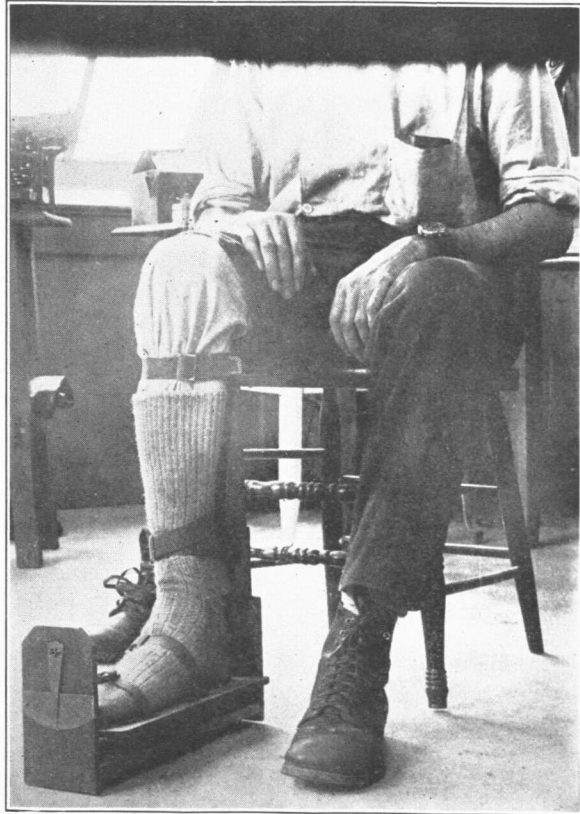


FIG. 30.—Measuring abduction and adduction of the ankle, psychological and statistical division

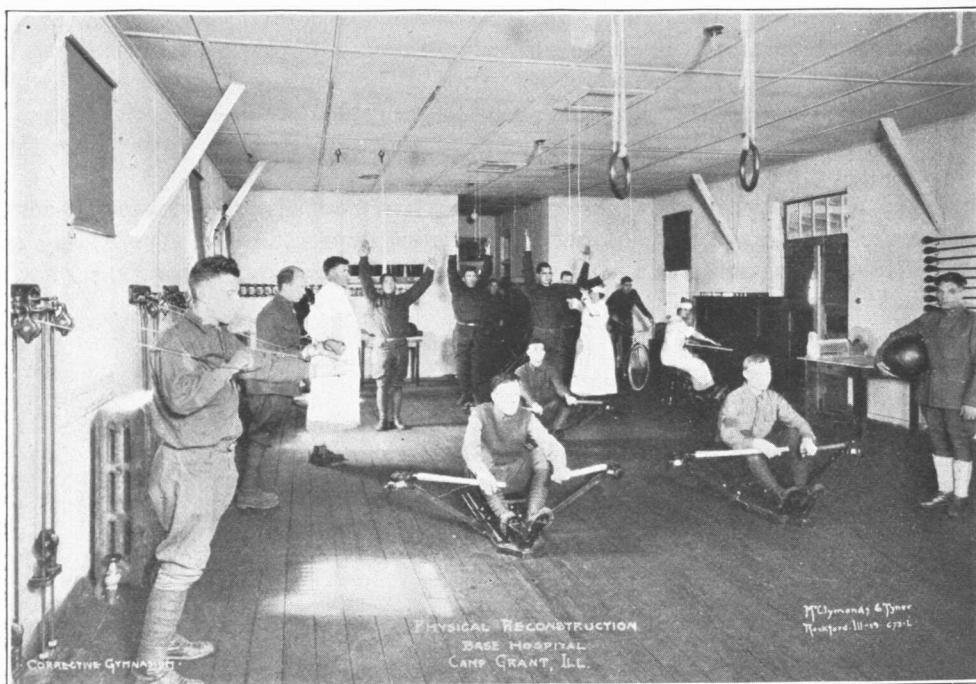


FIG. 31.—Corrective exercises in the gymnasium

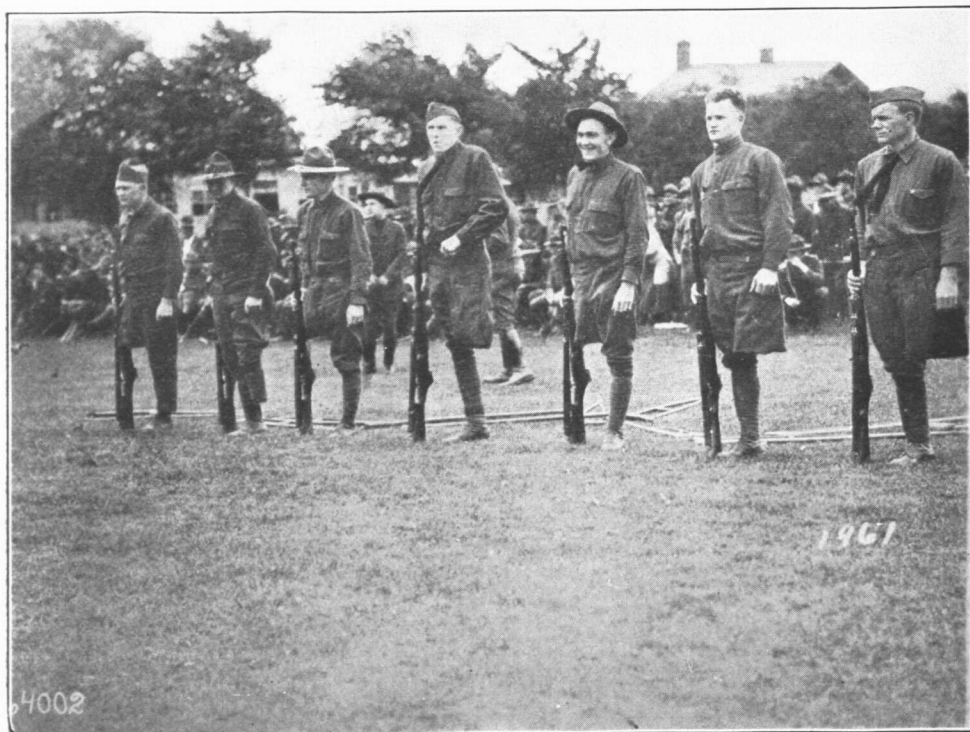


FIG. 32.—Contest in drill, manual of arms, field-day exercises



FIG. 33.—Wheel-chair race, field-day exercises



FIG. 34.—Plane fitted with special handle to develop grasping ability. The size of the hand piece was reduced as improvement progressed

of the subject which it covered. Furthermore, upon completion the student felt that a definite step toward his goal had been taken. The most popular and most valuable of all were the "Americanization" courses,²¹ which included American history and American Government, with elementary courses for illiterates. These courses were designed primarily for noncitizens who desired to qualify for citizenship papers and for others with no adequate knowledge or appreciation of this country and its Government.

TECHNICAL SECTION

The work of this section was divided into three fields—shop work and trade instruction, commercial work, and agriculture.⁹

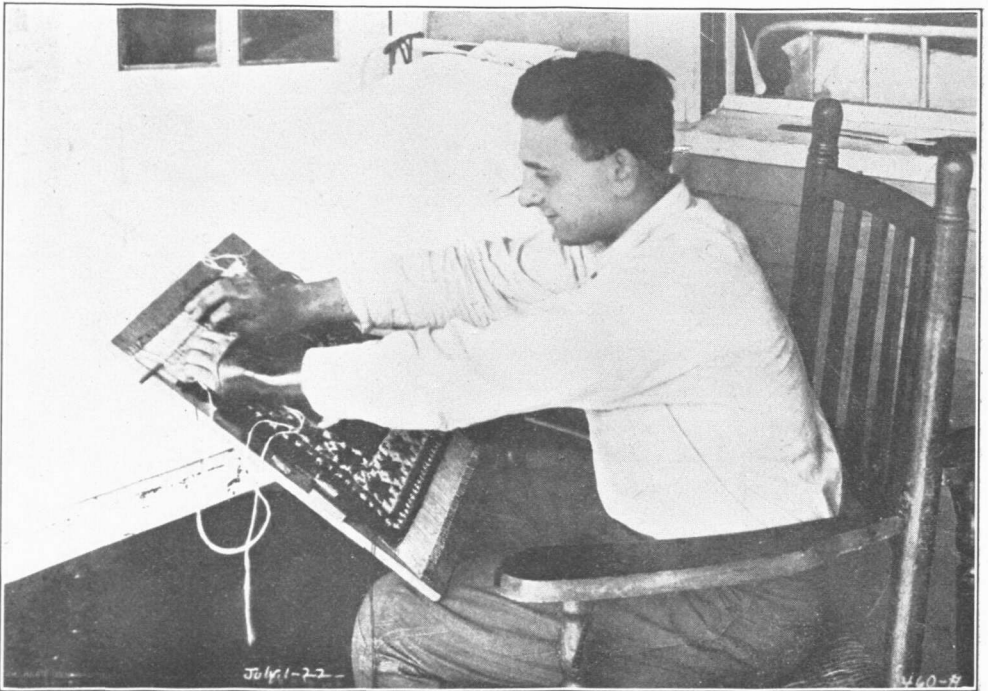


FIG. 35.—Rug weaving, for mobilizing stiffened joints and adherent tendons of the hands

In the shop work special attention was given to the therapeutic use of work from the standpoint of functional restoration.⁹ Men who could only partially flex the fingers were given work which required the grasping of tools, which had special handles that were gradually decreased in size as finger flexion increased. Men with stiffened ankles were caused to run foot-power machines, and such work as planing loosened stiffened elbow and shoulder joints. Coincident with the functional improvement each man's time was so occupied that he was becoming familiar with the rudiments of a new trade or increasing his knowledge of an old one.

Instruction in automobile mechanics was probably the most popular and most successful of all courses given by the technical section. The equipment of motor repair shops was available for use in every hospital or in the camp,

and quite complete courses were given. Salvaged automobiles, trucks, and motors were dismantled and used for demonstration purposes, and actively functioning repair shops were established where service was free of charge. Those engaged in blacksmithing, plumbing, carpentry, etc., were given actual work where it was needed about the hospital.

On the whole the results obtained in the curative workshops as experienced at General Hospital No. 3, Colonia, N. J., and which may be taken as a fair average, were satisfactory for individuals, but the number taking the courses was unexpectedly small, due either to superior attractions of other activities



FIG. 36.—Carpentry for mobilized elbow joints

or to the short time available in the average case, thus not permitting the complete acquirement of a trade.²²

In agriculture very little practical instruction could be given in farming operations per se, owing to the lack of suitable land and equipment.⁹ Such practical instruction as was given was accomplished mainly by visits to neighboring farms, truck gardens, etc. Extensive truck gardens were established in a few instances, but the work largely was confined to theoretical courses, farm accounts, farm management, and the science of agriculture. Instruction in stock raising was on a more practical basis in a number of instances where herds of swine, sheep, or cattle, and flocks of poultry could be maintained. Figures Nos. 46, 47, 48, and 49 are views of activities of the agricultural division.

PHYSIOTHERAPY SECTION

The organization of the subdepartments of physiotherapy is shown in Chart III. Table 1 gives an outline of the equipment furnished; many minor and nonstandard accessories are not listed.

TABLE 1.—*Physiotherapeutic equipment for 500, 1,000, and 1,500 bed reconstruction hospitals*

	Number required for various capacity hospitals		
	500-bed	1,000-bed	1,500-bed
Electric instruments:			
Galvanic sinusoidal machine, without meter.....	1	2	2
Bristow coils.....	2	3	4
Galvanic and faradic machine, with pole changer.....	2	3	4
Galvanic machine, with rheotome and meter.....	2	3	3
If the current of the hospital is alternating, the motor-generator sets for the conversion of alternating current to direct current should be supplied.....	3	5	5
Apparatus for the use of radiant heat and baking:			
Portable-light applicators made according to specifications No. 5 and No. 6 in the Surgeon General's Office.....	3	3	4
Hand-light applicators, including cord and stand.....	4	4	6
Diathermic machine, with connecting cable.....	1	2	2
Special equipment to be supplied on requisition for certain types of cases:			
Muscle-testing condenser.....	1	1	1
Motor vibrator, equipped with massage handle and applicators.....	1	1	1
Morse-wave generator.....	1	1	1
Static machine, special military model.....	1	1	1
Standard accessories for electrical and diathermic apparatus:			
Round sponge or asbestos electrodes.....	8	16	16
Testing electrodes.....	2	2	2
Special double-eye electrodes.....	1	1	1
Electrodes with wooden handle 8 inches long, with thumb screw and flat metal base.....	4	6	8
Wood felting, square yards.....	2	2	2
Asbestos-pad electrode.....	6	6	8
Block tin, 24-26-inch gauge (pounds).....	10	10	10
Rheophores, green and red (pairs).....	6	12	12
Vacuum-tube handles.....	4	4	4
Surface vacuum electrodes.....	4	6	8
Throat vacuum electrodes.....	2	2	2
Ear vacuum electrodes, curved and insulated.....	2	2	2
Double-eye vacuum electrodes, curved.....	2	2	2
Fulguration electrode.....	1	1	1
Metal sheet, 2 by 5 feet.....	1	1	1
Metal tube, 18 by 2 inches diameter.....	1	2	2
Special accessories for electrical and diathermic apparatus:			
Insulated electrode (rectal).....	1	1	1
Special ear electrode.....	1	1	1
Special tongue electrode.....	1	1	1
Needle holder.....	1	1	1
Hydrotherapeutic apparatus:			
Baruch control table and shower.....	1	1	1
Electric-light bath cabinet.....	1	2	2
Continuous bath.....	1	1	1
Whirlpool arm baths, Canadian type.....	2	2	4
Whirlpool leg baths, Canadian type.....	2	2	3

A weekly report of all physiotherapeutic work was sent to the Surgeon General's Office. The objects of this report were to give an idea of the number of cases treated and the number of treatments given in comparison with the number of aides on duty, to show the sources of the cases so that if any departments were not making full use of physiotherapy the advantages offered by this service might be brought to their attention, to give an indication of the variety of treatments employed in order that undue stress might not be laid upon any particular

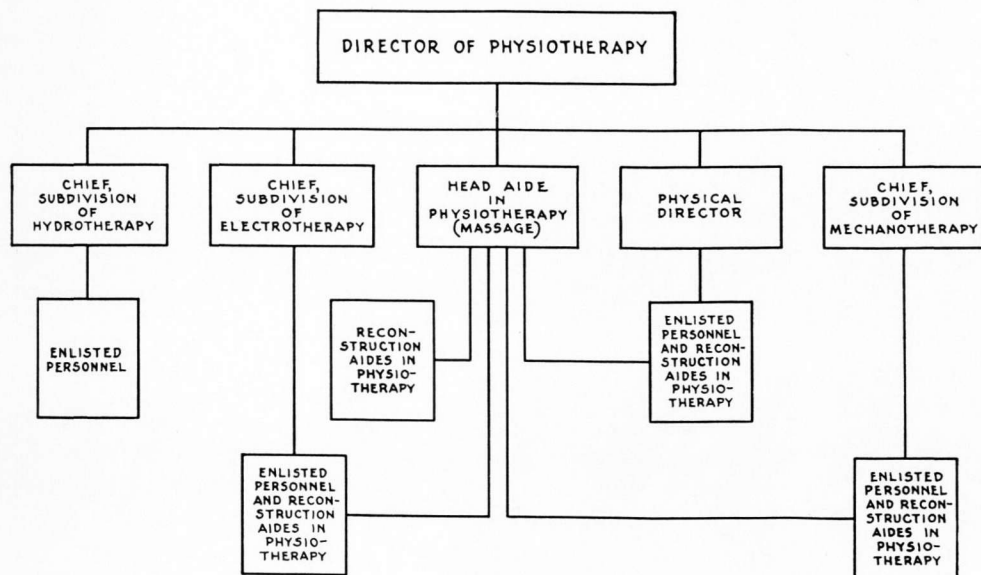


CHART III.—Organization of the department of physiotherapy in a reconstruction hospital

subdivision by the director in charge, and to check the arrival and departure of personnel.²³

The most evident value of physiotherapy occurred in the treatment of orthopedic and neurosurgical cases. The employment of physiotherapy in these two classes of cases became progressively more frequent with experience until there was scarcely a case in these two services which was not referred for such treatment. The appended table shows the comparative use to which the different branches of physiotherapy were put in a general hospital.²⁴



FIG. 37.—Gobelin tapestry making, for mobilizing stiffened joints and adherent tendons of the left hand

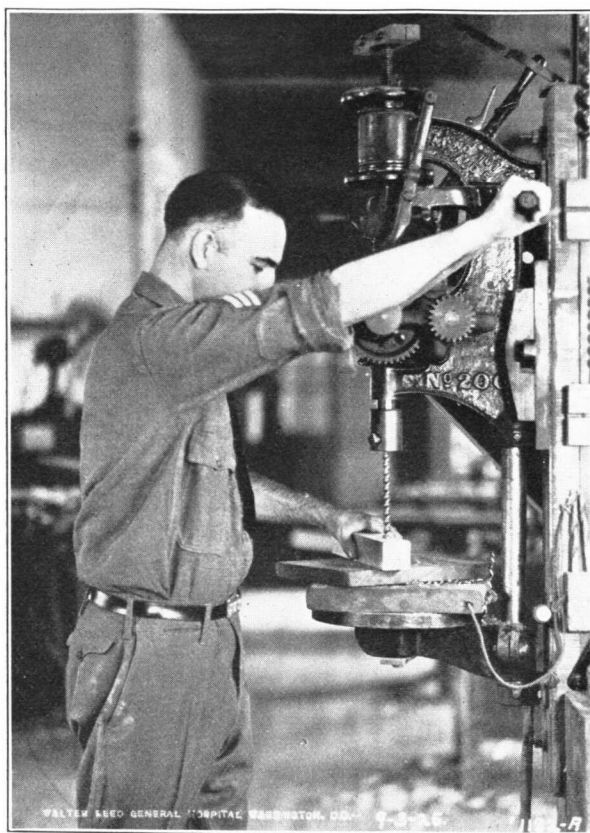


FIG. 38.—A hand-power drill press, with long crank, for producing motion in all joints of the upper extremity. Particularly useful to obtain circumduction of the shoulder joint

Report of physiotherapeutic activities, General Hospital No. 6, Fort McPherson, Ga., January 1, 1920, to June 1, 1920

Month	Patients treated	Number of aides on duty	Massage	Hydrotherapy	Electrotherapy	Remedial exercises	Total treatments given
January.....	300	31	7,297	2,275	2,164	5,793	17,529
February.....	295	30	5,434	1,493	2,154	4,993	13,834
March.....	279	23	5,331	1,760	1,699	4,618	13,408
April.....	242	18	5,822	2,620	2,404	5,302	16,148
May.....	211	16	3,924	1,113	2,397	3,508	10,942
Grand total.....			27,808	9,261	10,818	24,214	71,861
Approximate percentage.....			39	12	15	33	

Average number of patients per day..... 265
 Average number of aides on duty..... 23
 Average number of treatments per aide per day..... 28

The following account of the physiotherapy service, General Hospital No. 6, Fort McPherson, Ga., is given as being representative of the service elsewhere.

No definite organization for reconstruction was attempted at first at General Hospital No. 6.²⁴ The physiotherapy clinic was started as one part of the general surgical department of the hospital. As no very clear idea of the mission of such a department existed, every kind of case imaginable was turned over to the new clinic. It might be said that most of the first patients



FIG. 39.—A foot-power machine, for active exercise of the calf muscles

were those whose treatment was a puzzle to the medical and surgical staffs and to whom the new clinic could, possibly, do no harm.

In September, 1918, the first reconstruction aide in physiotherapy arrived at the post.²⁴ Just what to do with her was a problem to the staff. She was assigned finally to the reconstruction division (occupational), and under this division the aides who continued to arrive worked for several months. Each month more and more cases were intrusted to their care. From 5 cases assigned

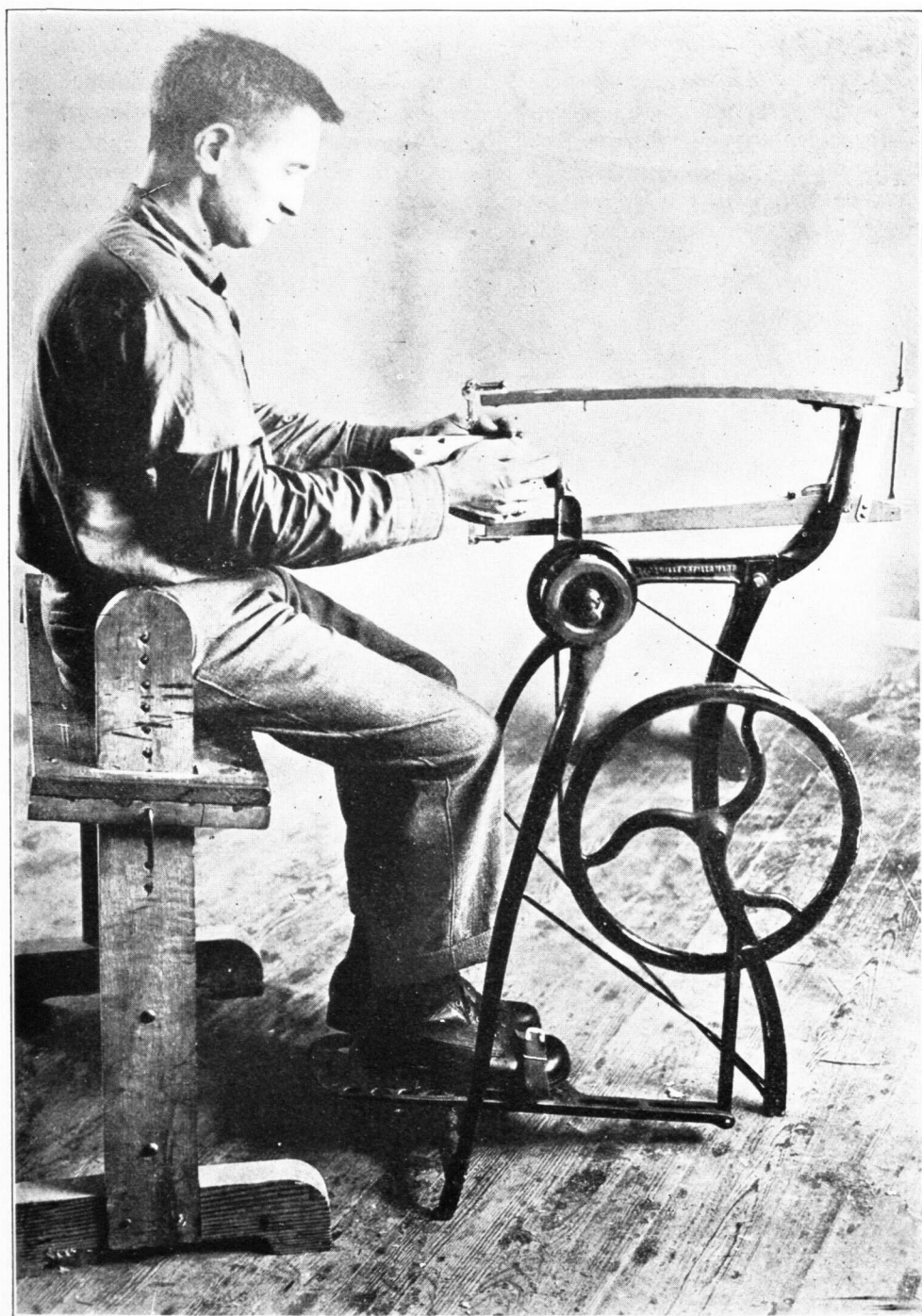


FIG. 40.—Treadle saw for mobilizing stiffened ankle joint. The action of the right foot is passive, the left foot furnishing the power

to the first aide in September the number increased to 200 by December 15, 1918. No physiotherapy center was established by the aides; all the work was done in the wards from bed to bed.

About this time new life was brought to the work by the additional force of a unit of 11 aides originally mobilized in New York for overseas service.²⁴ These aides were assigned to duty among the convalescent men, for the most part patients who had practically reached a maximum of improvement; consequently little in the way of definite results could be seen. However, even under these unfavorable circumstances, the work very soon attracted the atten-

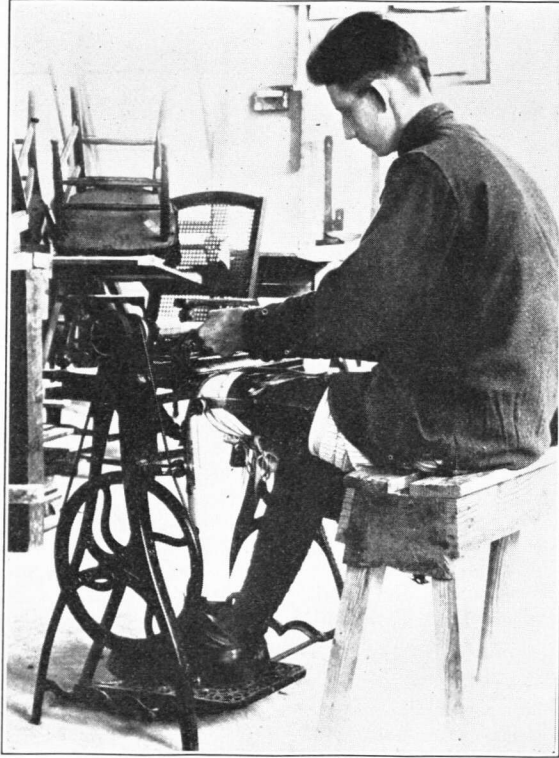


FIG. 41.—Treadle machines for mobilizing the knee joint in below-the-knee amputations

tion of the surgical staff, who more and more requested the services of the aides for their post-operative cases.

Ward A had the distinction of having the first surgical massage room. A small room adjoining the office was turned over to the aides, and the patients who were able came to this room for their treatments. This step aided effectively in establishing a professional atmosphere. Within a few weeks each of the wards was looked over and a room somewhere downstairs was found that could be turned over as physiotherapy headquarters for that particular ward. The men were assigned their time at which to report each day; failure to come was recorded and the patient reported to his ward surgeon. It might be noted

that little of this reporting was ever necessary. The men were quick to realize the value of the treatments and were remarkably punctual and regular in meeting their assignments.

At the same time an increasingly larger number of patients was assigned to the physiotherapy clinic. Electrical apparatus, consisting of a Bergonié chair, sinusoidal, high-frequency, faradic, and galvanic machines, had been installed and a hydrotherapy room had been thoroughly equipped.

Still a third branch of the work in physiotherapy was carried on in the gymnasium in Ward D. Quite an adequate set of apparatus had been furnished and about 100 patients were sent to this room daily for exercises. Two, and



FIG. 42.—In the woodworking shop—grasping exercise for stiffened joints of the hand

later three, aides in physiotherapy were sent to this gymnasium for duty. They gave massage treatments there and directed the remedial exercises.

Three definite and distinct agencies were struggling along by January, 1919, attempting to accomplish for the patients that which physiotherapy claimed to do. These three were the physiotherapy clinic, the gymnasium, and the physiotherapy aides in the wards.

At this juncture, however, the sensible and logical step for the progress of physiotherapy was taken. These three branches—the clinic, the gymnasium, and the organization of aides—were consolidated under capable leadership. Thanks to the power of organization and to the ability and personality of the officer in charge, the work of physiotherapy, long a puzzle to the personnel of the post, very soon began to have a definite meaning. It came to stand for

massage, electrical treatment, hydrotherapy, and remedial exercises—all of which brought hope and an interest in life to many whose faith in ever again being able to use their bodies in a normal way had nearly disappeared.

The electrical and hydrotherapy treatments at the clinic were coordinated with the treatments in massage and remedial exercises given by the aides. The massage work itself was left to the direction of the chief head aide. The work of the officer in charge was to examine the patients given the aides for massage and determine the further electrical and remedial treatment needed. The

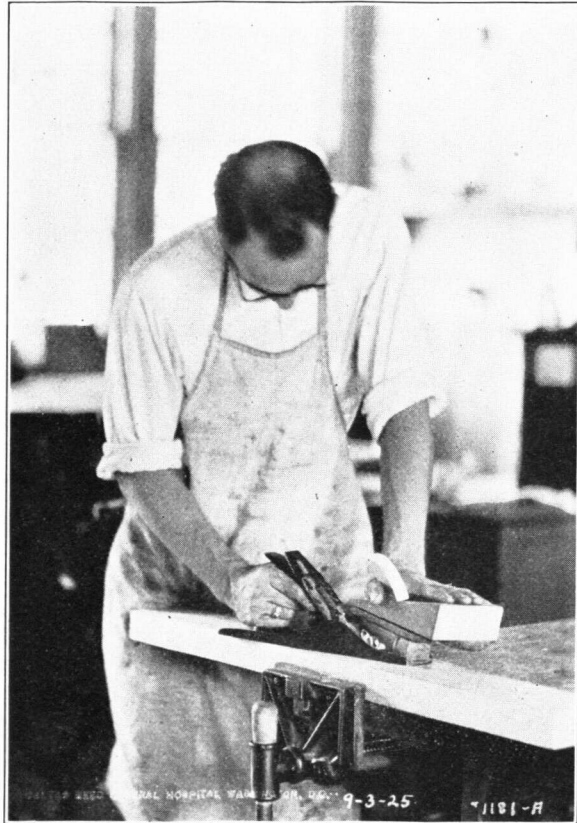


FIG. 43.—Special plane for musculospiral paralysis, maintaining dorsal flexion of the wrist, abduction of the thumb, and extension of the fingers while in use

schedule was so arranged that the patients after receiving physiotherapy treatment in their own wards were sent to the clinic for electricity or to the gymnasium for remedial work.

As time went on more and more aides were called upon to give electrical treatments. Their field increased to high frequency, slow sinusoidal, Alpine lamp, and vibration.

About the 1st of January, 1919, an important step was taken in the progress of the physiotherapy work in this hospital, when the chief of the surgical service asked for physiotherapy aides to give treatment to his nerve cases, and at this time no one fully realized how much this meant for the neurosurgical

department. However, when after two months this department had increased from a few scattered cases in two wards to four full wards, the importance of the recognition of the need of physiotherapy for these patients was readily seen. At first the preoperative cases only were intrusted to the aides. Very shortly, however, the aides were given postoperative cases of 10 days 'or 2 weeks' standing. In a short time the personnel of the neurosurgical department realized that massage, exercise, and electricity were vital assets in the recovery of peripheral nerve injuries.

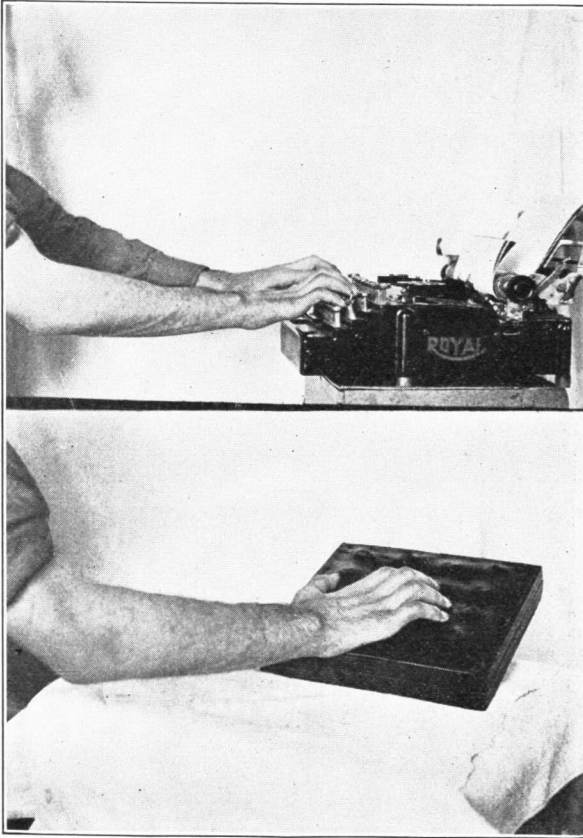


FIG. 44.—Typewriting for mobilizing stiffened joints resulting from ulnar nerve paralysis, and exercising the intrinsic muscles of the hand. Below—exercise formerly used for the same purpose. The fingers were placed on the raised spots on the block, endeavoring to cover those most widely separated

The personnel of the staff in the clinic was also changed. Prior to this time the officer in charge had supervised the work but had corps men only as assistants. Although these men were willing, their ignorance of anatomy and their lack of tact and painstaking care caused much of the work to be more or less ineffective. Early in March the service of six of the physiotherapy aides was requested for half of each day in the clinic to give interrupted galvanic electricity and faradic electricity to nerve injuries of the arm. Shortly after three more were requested to be in the clinic each morning to give the same treatments to nerve injuries of the leg.



FIG. 45.—Commercial course, typewriting



FIG. 46.—Commercial course, class in penmanship



FIG. 47.—Commercial course, posters by practical art class



FIG. 48.—Truck gardening

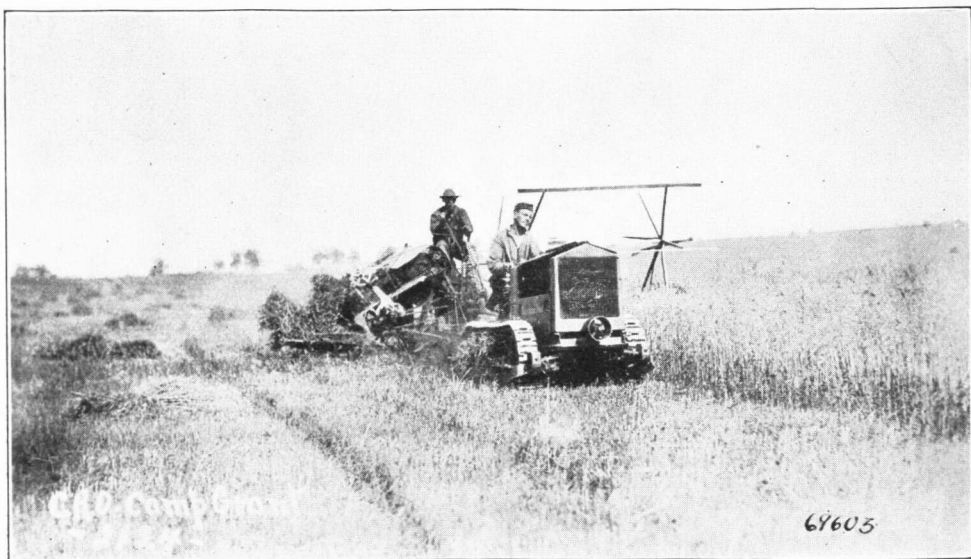


FIG. 49.—Practical agriculture



FIG. 50.—A simple milk-testing outfit in the agricultural course



FIG. 51.—Testing milk in a completely equipped dairying plant

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CHAPTER IV

IN HOSPITALS CARING FOR ORTHOPEDIC AND NEUROSURGICAL CASES

Though special hospitals were not maintained solely for either orthopedic or neurosurgical cases, special services were organized for such cases in a number of general and base hospitals and officered by men with special training for the types of work concerned. However, prior to the early part of the year 1919 both orthopedic and neurosurgical cases had been distributed largely through the military hospitals of the country, and only gradually, after the bulk of the overseas cases had arrived in the United States,¹ were they concentrated in the hospitals having special services for their care.

The two classes of cases under consideration here are particularly noteworthy because their number was large, their hospitalization was prolonged and they furnished the most evident exhibitions of the value of reconstruction, particularly with respect to physiotherapy, curative exercises, and the curative workshops, though, of course, their prolonged stay in hospital enabled them to profit to the fullest extent from all instructional courses. The outstanding features, however, were that the two pathological conditions largely responsible for the existing disabilities—contracted soft tissues and paralyzed muscles—generally speaking, yielded readily to a combination of surgery and physiotherapy, and that the nature of the progress of improvement was such as to permit its mechanical measurement. The larger peripheral nerves lying deep in the soft tissues and often in close proximity to the bones, it followed that lesions involving these two structures were frequent.

ORTHOPEDIC CASES

The greater number of the orthopedic cases which were in the hospitals after the year 1918 consisted of amputations and gunshot fractures which were complicated by osteomyelitis. They were largely concentrated in the orthopedic services of the following hospitals by the summer of 1919: Walter Reed and Letterman General Hospitals, General Hospitals Nos. 2, 3, 6, 10, 24, 25, 26, 27, 28, 29, 30, 31, 36, 48, and 41, and the base hospitals at Fort Riley, Kans., and Fort Sam Houston, Tex.²

AMPUTATION CASES

As a class, the amputations called for much less physiotherapeutical treatment than the fractures, for the involved structures had been removed by the process of amputating. The physiotherapy measures required by the stumps consisted principally of the action of radiant heat and light and of massage to mobilize adherent scars and to prevent or remove edema and motion of the neighboring joints to prevent contractures. On the other hand, the amputations called for much more in the line of what might be called curative exercises, which took the form of instruction in the use of the artifi-

cial limbs and were of extreme practical importance. Those for the upper extremity consisted of such instruction as would enable the wearer to obtain maximum results from the appliance by the motivating muscular action. Those for the lower extremity were more complicated and important, as the items of balance, proper joint action, and weight bearing were concerned in the acquisition of correct locomotion.

With all stumps massage, heat, and compression bandages were used as indicated to obtain the proper condition of the soft parts in order to insure the best condition possible for the reception of the appliance. This frequently called for the mobilization of terminal adherent skin scars by heat, massage, and diathermy, and for the application of such stimulating agencies as the actinic ray and electric light to small granulating areas of an indolent nature. These measures assisted the weight-bearing exercises, end pressure against a firm cushion, in accustoming the stump to the reception of the body weight where such was intended. Following the receipt of the artificial leg, instruction was given in balancing and in the proper muscular action necessary to move it in a natural manner when walking. Figure 52 represents the type of such exercises.

OSTEOMYELITIC CASES

The osteomyelitic cases required a great amount of attention from the department of physiotherapy. The original injury, subsequent operations, chronic inflammatory conditions, and disuse caused massive bodies of scar tissue, atrophy of bone and soft tissue, contractures, and a condition of poor circulation, with its resulting edema, and sluggish granulations. The various physiotherapeutical measures available were of invaluable assistance to corrective surgery in removing these conditions. The whirlpool bath, the contrast bath, the paraffin bath, radiant heat and light, and massage largely were used for their pronounced qualities as local circulatory stimulants and to improve local nutrition. These changes in turn assisted in the absorption of scar tissue, and diathermy was thought to have a direct softening action which further aided in this absorption.^a The same measures relieved contractures, and, together with active and passive motion, gradually restored function to stiffened joints when the limitation of motion was not due to bony involvement. Under such conditions, active motion of an involved joint is usually of greater benefit than passive motion, but is often limited by an exaggerated pain sensibility. Games of various sorts, particularly those requiring active exercise of a competitive nature, such as baseball, potato races, etc., were often used to overcome this more or less voluntary inhibition of the motion of a joint and the use of the motivating muscles. In the excitement of competition imaginary or slight pain was forgotten and joints were not only freely moved to the limit of available motion, but more or less tension was placed on the contracted structures which tended to lengthen them in a manner which was even more efficacious than gentle, continued force employed passively. The tendency to forget too completely under those conditions was so common that constant supervision was necessary to prevent a too ardent use, with a subsequent reaction which delayed progress.

^a See subsequent pages under heading "Neurosurgical cases" for detailed account of the use of physiotherapeutic agencies.—Ed.



FIG. 52.—Exercises teaching the use of artificial legs—learning the correct balance and step. Cane used as little as possible

The same idea applied to activities in the curative workshops, in that use of disabled members was more free when the attention of the individual was absorbed by an interesting occupation. Metal working, wood working, toy making, weaving, etc., were employed where tissues and small joints of the hand were involved; weaving on large looms, and drills and other machines run by means of a handle on the rim of a large wheel, were used to increase the range of motion of the larger joints of the arm.

NEUROSURGICAL CASES

The physical aspect of reconstruction in neurosurgical cases was most prominent in lesions of the peripheral nerves. Peripheral nerve cases were collected in special services in the following-named hospitals at about the same time as the orthopedic cases were: Walter Reed and Letterman General Hospitals, General Hospitals Nos. 1, 2, 3, 6, 10, 11, 26, 28, 29, and 41, and the base hospital at Fort Sam Houston, Tex.³ The cases of this type which were in General Hospital No. 1 were soon transferred to General Hospital No. 41, and no cases in addition to those derived from its own service were sent to General Hospital No. 10. There were 2,347 of these cases actually present in hospital on May 1, 1919.³ Of these, 147 were lesions of the brachial plexus, 589 of the ulnar nerve, and 529 of the musculospiral, 433 of the median, 349 of the sciatic, and 283 of the external popliteal.

The conditions found with old peripheral nerve lesions were decidedly discouraging at first glance, as the atrophy, contractures, and circulatory disturbances superimposed upon the nerve lesion, and often with complicating and complicated orthopedic conditions, seemed to offer an almost hopeless field. But coincident with the necessary surgical procedures to remove infection and restore anatomical continuity to the bones and nerves, radiant heat and light, massage, baths, and diathermy aided greatly in the removal of local pathological conditions and in preventing further loss by atrophy, while the galvanic and sinusoidal currents were used to maintain the contractive ability of the paralyzed muscles and improve their general tone. The curative workshop employments furnished active exercise for muscles recovering from paralysis and aided greatly in the removal of the fibrosis of the small joints following interference with nerve function. The galvanic current was also of the greatest value in the definite diagnosis and prognosis of these cases, aiding in the location of the nerve lesion and in the differentiation as to the anatomical cause and its degree.

APPLICATION OF PHYSIOTHERAPY TO NERVE INJURIES ^b

The aftercare of cases of peripheral nerve injuries embraces three principal methods of treatment; namely, operative interference, corrective splinting, and the physical measures which are grouped under the term "physiotherapy." Accordingly, the Surgeon General, the late spring of 1918, placed physiotherapy upon its present basis, defining it as "physical measures such as are employed under physiotherapy, including hydro-electro-mechano-therapy, active exercises, indoor and outdoor games, and passive exercises in the form of massage."⁴

^b The following account of the application of physiotherapy is based on a report on "Application of Physiotherapy to Nerve Injuries," by Maj. J. B. Montgomery, Medical Corps, United States Army. On file, Historical Division, S. G. O.

In the treatment of peripheral nerve injuries there are two phases which are especially unusual. First, the benefits derived from surgery—which, in given cases, is absolutely essential—are only a means to the functional result after months of tedious treatment. The brilliant, immediate results such as can usually be associated with surgical operations are not obtained by any other method. Secondly, there are no other groups of cases in which physiotherapy plays such a vital part in securing a maximal functional result. This applies not only to the cases of nerve injuries which are showing spontaneous recovery, but also to those which have had surgical intervention in the form of neurolysis, neurorrhaphy, and the like.

RECORDS

In the physiotherapy treatment of nerve injury cases it is essential that the director of physiotherapy make a clinical examination, together with a brief history. The following notations should be included on a suitable clinical record form: Cause and date of injury; date of healing of wound; time of appearance of paralysis in relation to injury; treatment up to present time, including surgical measures; muscle groups paralyzed; area of sensory impairment; degree of atrophy; extent of fibrosis; presence of trophic ulcers; vasomotor changes and neuromata; formication or the "D. T. P." (distal tingling on percussion); measurement of girth of affected limb as compared with the opposite or normal limb, and measurements with suitable protractors of any limitation of joint mobility, if such be present. The electrical reactions should be taken, following which the specific treatment should be outlined, with proper instructions to the aide to whom the case is referred. A report is then sent to the surgeon of the findings of the electrical reactions, stating in terms of pathology the condition of the nerve as interpreted from the reactions, and the outline of treatment which the patient will receive. A monthly progress note and report to the surgeon is in order, with special reference to any material changes in electrical reactions, return of sensory or motor functions, progressive advancement of the D. T. P. and the like. The practice of personal consultations with the surgeon who has charge of the patient can well be emphasized.

PATHOLOGY

In a limb with a paralyzed muscle group and associated sensory and trophic disturbances there occur many pathological processes. Primarily, a progressive muscular atrophy, with a fibro-fatty degeneration of the muscle fibers, takes place. A circulatory deficiency due to trophic disturbances and loss of muscular contractions is present. Function of one or more joints is interfered with. The antagonistic muscle groups are unopposed, with resulting overstretching of the paralyzed muscles, which may lead to contractures. Due to a loss of function of joint movements and fibrosis of the articular capsules, adhesions of the articulating surfaces and of the adjacent tendons may supervene, with limitation of motion ranging all the way from simple stiffness to complete ankylosis. Thus, without adequate treatment, deformities, much worse than the original paralysis may be present.

HEAT

BATHS

WHIRLPOOL BATH

The whirlpool bath, an aerated hot-water bath, is suitable for arm or leg cases. The temperature of the water can be gradually increased to 110° or 115° F., and the duration of its application is established at 20 minutes. This bath was introduced during the World War and has proved to be the most curative of all physiotherapeutic agencies in the treatment of cases of peripheral nerve injuries. The increased vascularity and softening effect upon tissues results in a relaxation of the muscular elements, which become more supple and



FIG. 53.—Ischemic atrophy, common after nerve injuries and one of the conditions most resistant to physiotherapy

elastic. Muscle spasm is relieved and increased mobility of the joints results. A most important feature of this treatment is that the subsequent massage is more efficiently administered and such treatment can be adequately given in much less time, as the aide starts her manipulations on a limb which is softened, relaxed, and in a state of active hyperemia. Further, any manipulations or stretching of joints and tendons is more easily accomplished, is less painful, and the patient's apprehension is less acute. The use of this bath is also an ideal preparation of the muscles for testing the electrical reactions. Occasionally cases of irritable nerve injuries will be made more irritable and the whirlpool bath can not be utilized. One case of hyperesthesia of the median nerve obtained relief from a bath, the temperature of which was maintained between 70° and 80° F.

CONTRAST AND CABINET BATHS

Under this phase of physical measures two other baths should be mentioned, although their use in the treatment of nerve injuries is somewhat limited. The contrast bath is used where a circulatory stimulation is desired and has been aptly spoken of as "circulatory gymnastics." Immersion of the limb for a period of about two minutes alternately in a hot-water (100° to 110° F.) bath and then in a cold-water (60° F.) bath is the mode of application. As a result, the vessels of the part are alternately dilated and contracted. The cabinet bath and general hydrotherapy are used mainly in the treatment of the

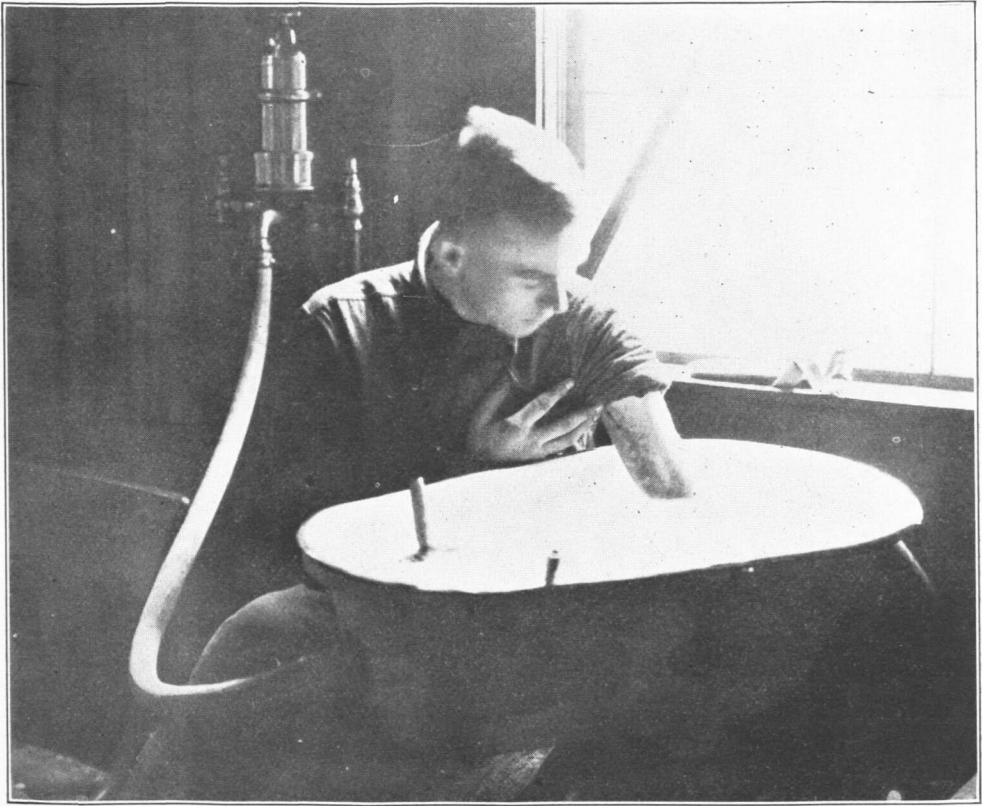


FIG. 54.—Whirlpool bath

patient's general condition, as they have a marked tonic as well as eliminative effect. The cabinet bath is equipped with approximately 50 electric lamps (carbon filaments). The patient is seated on a stool with his head exposed. The temperature ranges from 120° to 160° F., and the exposure is from 4 to 10 minutes. This bath is followed by the "hydro" of tepid overhead and circular showers and the Scotch douche, the latter consisting of more or less rapidly alternating streams of jets of hot and cold water under a pressure varying from 10 to 30 pounds. The cabinet bath produces a profound physiological action. These effects are, briefly, a profuse diaphoresis with dilation of the superficial vessels, an increase in body temperature, pulse and respirations,

and a marked increase in the excretion of the urinary solids. The follow-up hydrotherapy enables the relaxed vessels to regain their tonus, the temperature, pulse, and respiration become nearly normal, and the reaction, a feeling of general well-being, is attained.

PARAFFIN-WAX BATH

A modification of the whirlpool bath in the form of the paraffin-wax bath has been more recently introduced. A temperature of 150° F. is attained, and it is advocated that a more active hyperemia is produced, with a correspond-



FIG. 55.—Control table for Scotch douche

ing beneficial effect upon the tissues. There is some doubt whether this bath has any advantages over the ordinary whirlpool bath.

HOT-AIR BATH (RADIANT HEAT AND LIGHT)

The hot-air, steam, or vapor baths have been practically superseded by dry heat derived from radiant heat and light applicators. This is commonly, although improperly, spoken of as "baking." There are different styles and sizes of applicators, employing four, eight, or more electric incandescent lamps, preferably with carbon filaments. In addition to these ordinary forms of "bakers," which are portable and can readily be adjusted to the part to be treated, the large, nonportable, deep, phototherapy applicator, with a non-focusing 1,500-watt tungsten filament lamp, is of special value in the deeper

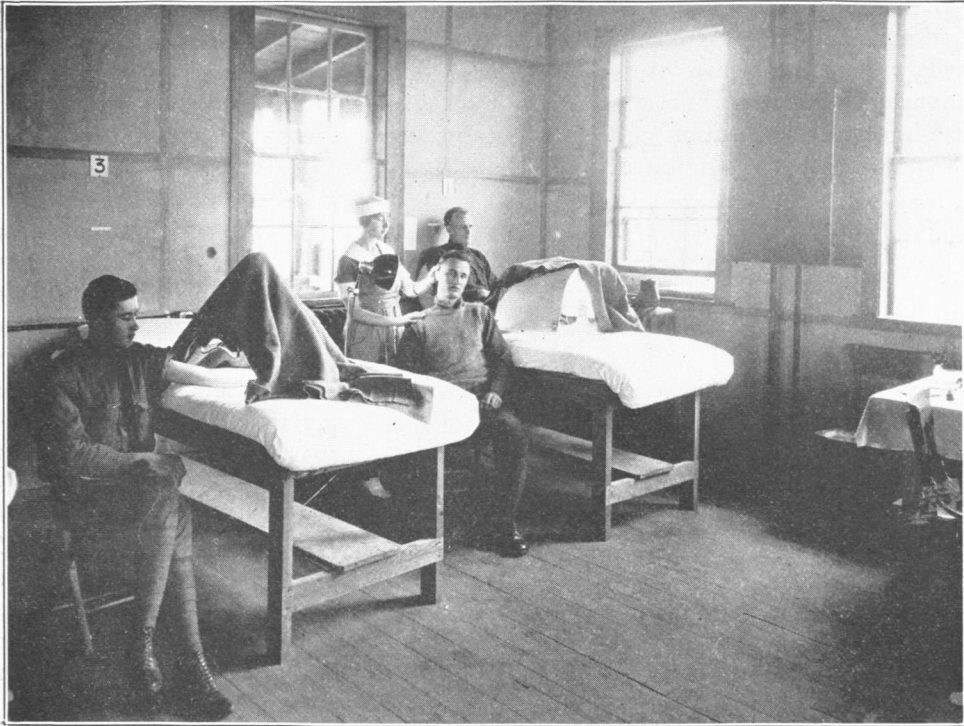


FIG. 56.—Radiant heat and light treatments of the extremities



FIG. 57.—Radiant heat and light treatment of the entire body

penetration and higher temperature obtained. These applicators are built in various sizes. They are convenient and easily utilized, and hence have practically superseded other forms of dry heat. There is some, though very slight, chance of producing burns, especially over an anesthetic area, but with proper use an even distribution of heat is obtained over the entire exposed area and the risk of a burn is minimal. The claim that colored lamps have an increased

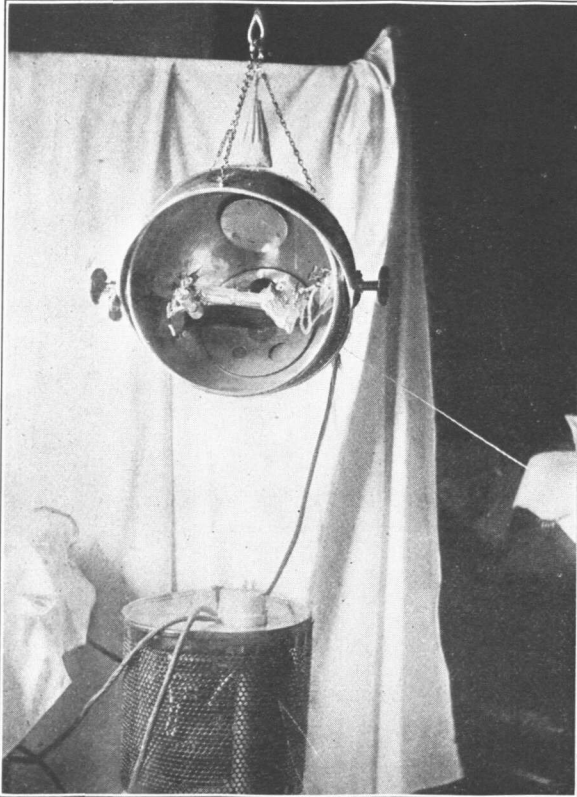


FIG. 58.—Alpine lamp

therapeutic value has not been substantiated. Radiant heat and light is applicable in many cases where the whirlpool bath can not be used, viz, where there is an open wound which could not be subjected to the water bath, and in nerve injuries affecting the shoulder, back, buttock, or thigh.

A brief statement of the physics of the light as derived from the incandescent lamp is of interest. In the spectrum of the incandescent carbon lamp approximately 93 per cent are infra-red rays. Hence the physiological effect of the use of incandescent lamps results from the heat or infra-red rays. These rays have no pigmenting effect, but do penetrate into the tissues, causing an active hyperemia with an elevation of the skin temperature. With the increased vascularity, improved nutrition,

and increased cellular activity, the rationality of this treatment as a preliminary to massage and passive and active exercise is readily understood.

MERCURY VAPOR LAMPS

The mercury vapor or quartz lamps, both the air-cooled and water-cooled types, also have a limited use. The actinic rays derived from these lamps are extremely stimulative, and an exposure to these radiations may result in erythema of from a mild degree to bleb formation. Hence, it may be used as a form of counterirritation in neuralgia, neuritis, and like conditions. Trophic ulcers and skin lesions associated with trophic disturbances may likewise be treated with these stimulative radiations.

MASSAGE AND PASSIVE MOVEMENTS

Of equal importance with heat in nerve injuries are massage and passive movements. In fact, one term should be devised for the combined application of heat, massage, and passive movements. In cases of nerve injuries this triad of physical measures should be started at the earliest possible time and should be continuous, and every paralyzed muscle group should receive this form of daily treatment.

Passive movements are carried out only upon the relaxed limb. These movements should be executed slowly with firm, steady pressure. Avoidance of sudden movements or jerking needs no comment. The particular joint

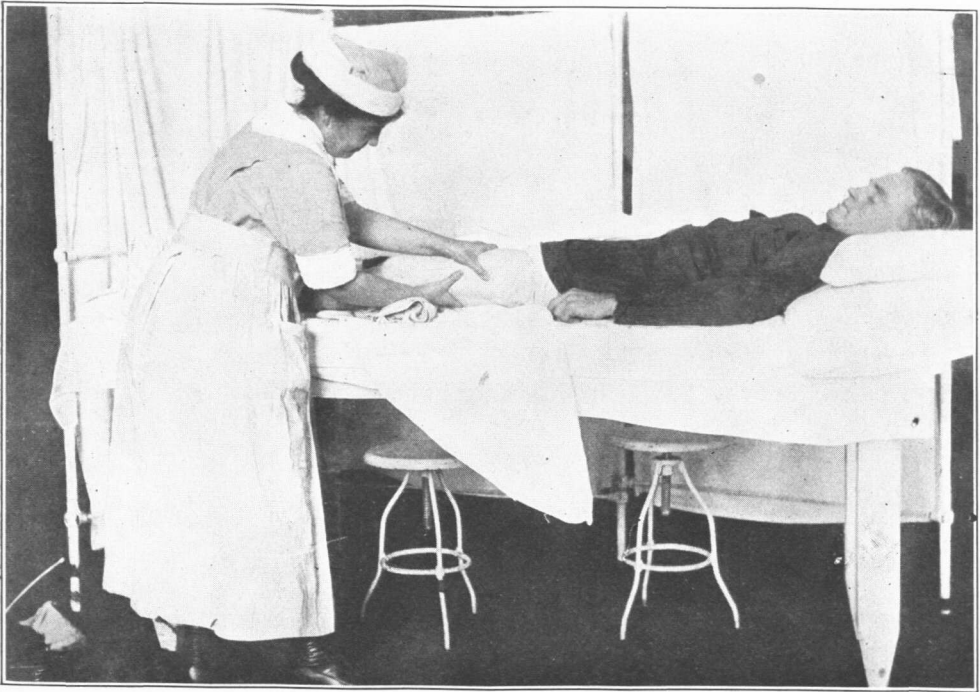


FIG. 59.—Massage of thigh muscles. Note separation of muscle groups by the thumbs

should be passively put through its entire range of movements. Certain cases of limited joint mobility require a certain steady pressure to effect maximum range of motion. The term "stretching" seems most appropriate.

Massage and passive movements, together with preliminary heat, are the most important treatments for paralysis. Their chief value consists of the maintenance of the nutrition of the affected muscles and the prevention or stretching of adhesions of joints, muscles, and tendons. The fibrosis and contraction of articular capsules, especially of the finger joints in cases of ulnar, median, and musculospiral paralysis, needs special mention. Stiff fingers or "griffes" readily result from paralysis of these nerves due to the loss of voluntary contractions. The attending loss of function—that of prehension—is very grave. With early passive motion treatment, which even the patient can often do, this single deformity is readily prevented. Another important benefit de-

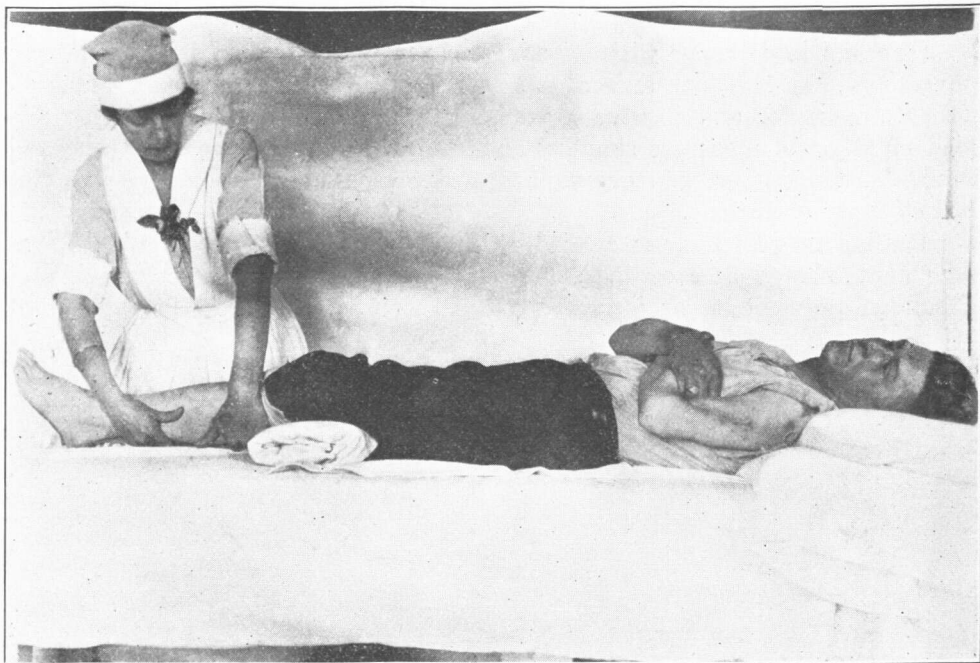


FIG. 60.—Massage of the calf muscles

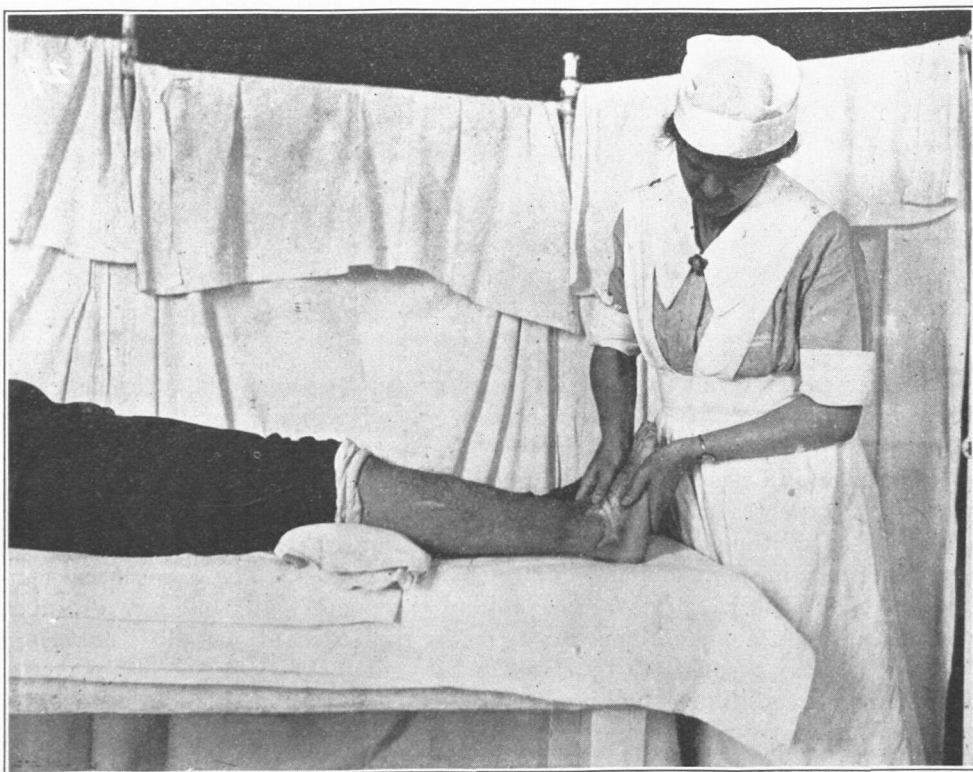


FIG. 61.—Massage about a recently healed wound

rived from massage is the nutritional improvement in the skin and subcutaneous tissues, thereby lessening the occurrence of trophic ulcers and eczematous conditions. Adherent scars can be loosened and freed from the underlying tissues to a greater or lesser extent. Deep massage is often of value when applied to the area of an old healed wound preliminary to an operation, in order to stir up any latent infection if it be present. Passive movements used in conjunction with massage are executed to increase the range of movements of stiffened joints, to stretch contracted scars, to prevent the formation of adhesions in regional joints, and to forestall contractures and adhesions in the paralyzed muscles and tendinous processes. With the administration of these manipulations the paralyzed muscles must be relaxed with the deformity overcorrected. For example, in a musculospiral paralysis the forearm and hand must be supported (usually

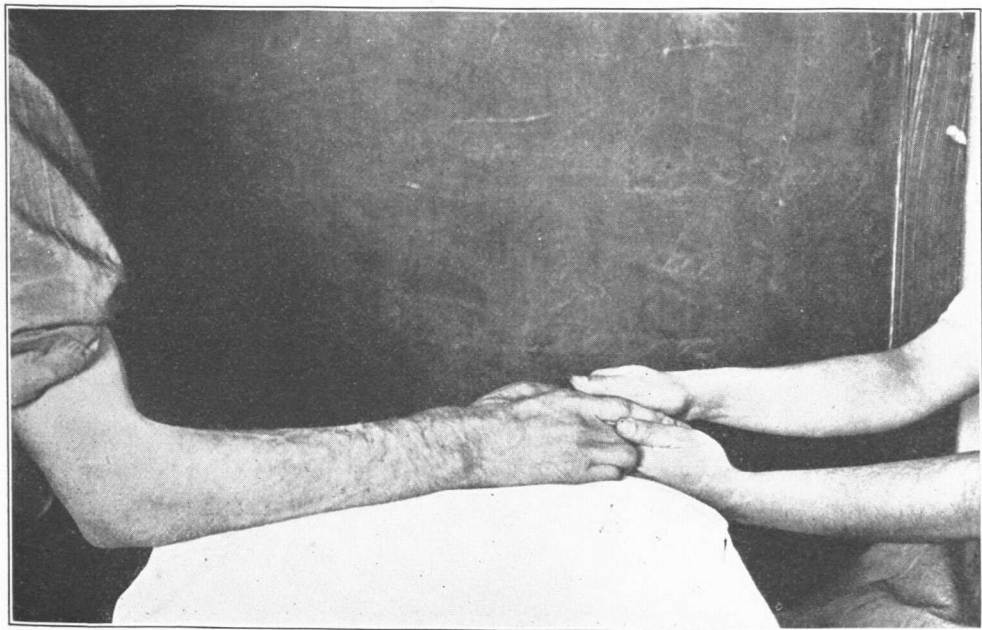


FIG. 62.—Massage to retain mobility in finger joints after nerve injury

on a small table) with the wrist in moderate dorsiflexion. In an external popliteal nerve paralysis the foot should be supported in dorsiflexion. In certain paralyses the corrective splint may not necessarily be removed, as in a circumflex nerve injury with deltoid muscle paralysis. With the abduction or airplane splint all treatment can be given to the shoulder girdle musculature with the splint in situ. However, if the splint is removed, the patient should be lying flat on his back with the arm in abduction and the forearm supported, resting on the plinth or table. The question of the vigor to be used in massage depends upon the individual case. Gentleness in early nerve injuries and cases of hyperesthesia is imperative. Following surgical operations, massage should be avoided over the operated area. This also holds true relative to sites of injury in any case. In nerve sutures where extreme flexion or extension of the adjacent joint has been necessary to secure end-to-end anastomosis, due to loss of nerve substance,



FIG. 63.—Massage to release adherent scar in amputation stump



FIG. 64.—Stretching a fibrosed ankle

no movement should be permitted for a period of from one to two months. Massage to be effective must be given correctly. It is an art which practice alone can teach. The experienced patients know the difference between massage and mere "rubbing." For real massage a thorough and practical knowledge of anatomy is absolutely essential. If the operator is rough and too vigorous the possibility of doing harm is apparent.

ACTIVE EXERCISES

The value of active exercises in nerve injury cases can not be too strongly emphasized. These exercises can be given only after return of voluntary power,



FIG. 65.—Resistive exercise for strengthening thigh muscles in preparation for use of artificial leg

must be carefully adapted to the individual case, and usually should follow the regular treatment of heat, massage, and passive motion. Exact and purposeful movements should be carried out, but not to the point of extensive fatigue. In fact, the execution of these natural movements and the use of resistance must be guided solely by this factor of fatigue. Without proper supervision much harm may be done, the progress of regeneration halted, and recovery delayed accordingly. Active exercises are spoken of as reeducation, and such have been systematized and placed on a true scientific basis in the larger medical clinics devoted to the treatment of cases of infantile paralysis. The value of active exercises is obvious. The patient himself is building up his weakened muscles and overcoming the functional inactivities attendant upon the long period of

relative immobility. This contractility enhances the nutrition of the paralyzed muscles and mobilizes the articulations. It greatly assists in the formation of substitutional movements. With the progress of voluntary movements and endurance of the muscular contractions the patient can be assigned to specialized work in the curative workshops of the occupational therapy department. Here, with proper supervision, the coordination and strength of muscular contractions under the stimulation of the voluntary impulses will progress with perhaps more rapidity than in any other form of treatment. Associated with active exercises and voluntary functioning, mechanotherapy has a niche. The various forms of apparatus (Zander's and McKenzie's types) are useful in strengthen-



FIG. 66.—Testing muscle reaction with galvanic current

ing the muscular contractions, in causing the normal functioning in its proper direction, and in stretching shortened tendons or stiffened joints.

ELECTROTHERAPY

Much discussion has been raised as to the real value of electrical currents in the treatment of nerve injuries. There is no doubt but that some over-enthusiasts have made unsubstantial claims relative to its merits and that many who have confined themselves to a small specialized branch of electrotherapy have made exaggerated statements. However, it can not be denied that electrotherapy is a valuable adjunct to the primary triad—heat, massage, and passive movements—in the treatment of nerve injuries.

IN PARALYSIS

The treatment of nerve palsies with electricity is a matter of considerable discussion as to its true value. It is the usual statement that the muscles supplied by the affected nerves should have daily stimulations or contractions with an electrical current.

GALVANIC CURRENT

Since in a paralysis the nerve trunk is inexcitable, stimulation of the muscle itself is the only alternative to cause a contraction, and interrupted galvanism is the form of electricity which is usually advocated. From the writer's experience in physiotherapeutical treatment of a large number of peripheral

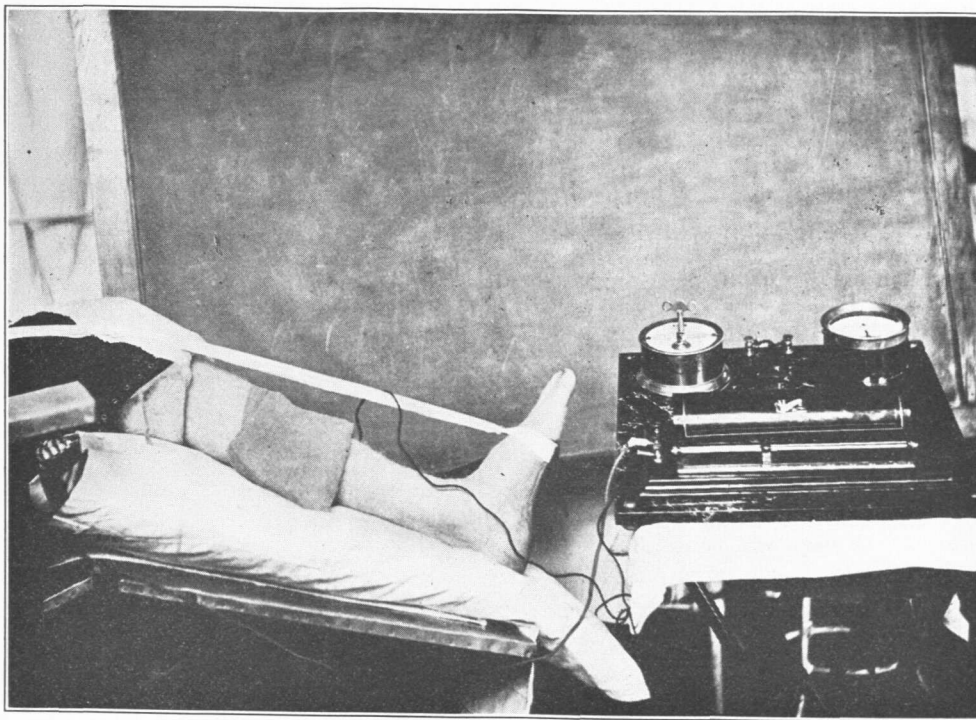


FIG. 67.—Interrupted galvanic current to muscles in case of injury to the external popliteal nerve, with foot drop

nerve injuries due to gunshot wounds, this has been a false procedure and no functional improvement could be attributed to this one therapeutic method. With the interrupted galvanic stimulation, only a short jerk is elicited for each contraction, and only a small portion of the muscle is affected, namely, that part adjacent to the active electrode. Again, too much stress has been laid on the value of this muscular contraction. It is difficult to conceive of any value in this localized spasmodic contraction or jerk as a means of increasing nutrition or preventing muscular atrophy. This treatment may cause considerable pain or discomfort. Small though slowly healing burns, especially over anesthetic areas, not infrequently result from the application of this current. Further to determine its efficiency from the clinical aspect, selected cases of peripheral nerve injuries received physiotherapy treatment, one group with

and one group without interrupted galvanism. Again, the same cases were treated with interrupted galvanism for a period of several months and then received the same treatment, excepting that the galvanic contractions were omitted. No difference in the rapidity of progress could be noted in either group of cases. Accordingly this method of treatment was discontinued, although a sinusoidal current was used in selected cases in which an appreciable contraction of the paralyzed muscle groups could be obtained. The contraction from the sinusoidal current is rhythmical, smooth, prolonged, not at all painful, and perhaps is of material assistance in keeping the muscular elements in a better nutritional state.

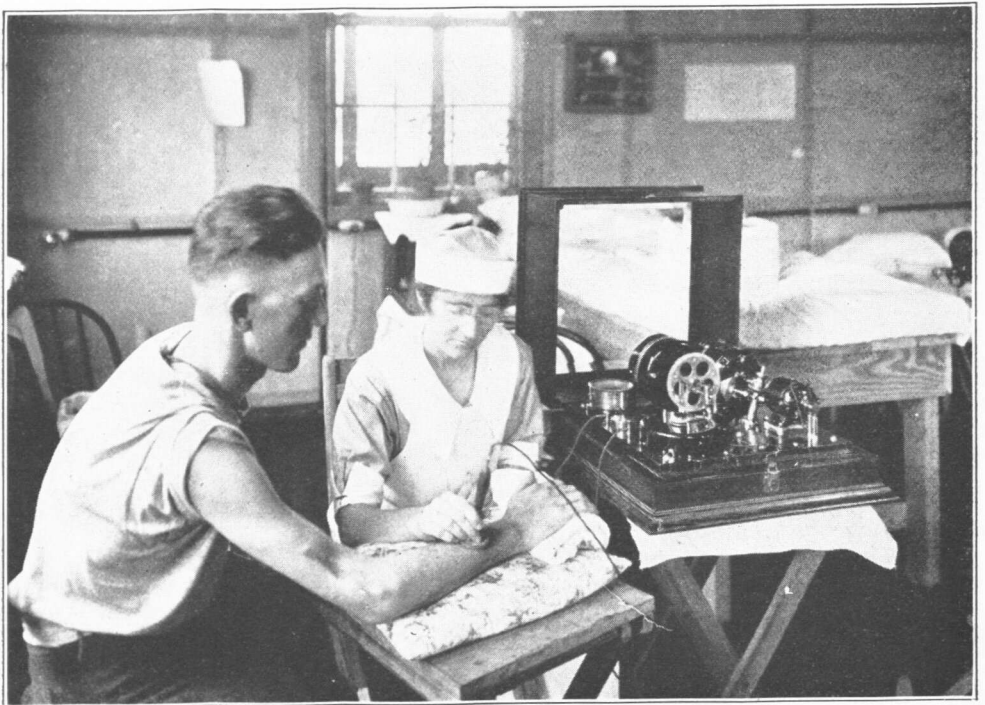


FIG. 68.—Muscle treatment with sinusoidal current. The electrode was usually bound in place

FARADIC CURRENT

The faradic current is of little use unless a contraction is obtained. Recovering peripheral nerve cases have voluntary power for some time prior to any faradic irritability. These cases are then amenable to active exercise or reeducational movements and faradism has little place in their treatment, although at times it is a very useful procedure in conjunction with active movements for supplementing the voluntary contractions of affected muscles. However, there is one large group of cases, which, strictly speaking, is not included in peripheral nerve injuries yet are associated with them in physiotherapeutical practice, namely, the functional or hysterical paralyses, in which faradism plays an important part in the treatment. When the faradic current is applied to either the nerve trunk or motor points of the affected muscle groups in this type of case, a normal muscular response is obtained. This is indicative of an intact

nerve trunk, and without exception is absolutely diagnostic that no organic lesion of the spino-muscular neurone is present. The muscular contractions which are obtained in this type of case with faradism are utilized as a form of suggestive treatment which has proved to be most valuable. The patient is placed so that he can voluntarily use the muscles of both the affected and the opposite limb, and with the active faradic electrode in place on the nerve trunk or motor points of the paralyzed muscle group he is asked to contract these muscles and those of the other limb, the faradic contraction then being brought about. This is only one of the procedures whereby faradism is used as a part of the suggestive treatment of these cases.

IN IRRITATIVE LESIONS

HYPERESTHESIA, CAUSALGIA, HYPERTONICITY

A large group of cases for which the galvanic current is applicable are those with irritative lesions—hyperesthesia, causalgia, and those with hypertonicity with a tendency toward contractures. The median and internal popliteal nerves are especially prone to such lesions. The writer has also treated one case of partial degeneration of the anterior crural (femoral) nerve with intense hyperesthesia of its sensory distribution. A sedative form of treatment is called for in these cases. The positive or anodal electrode has a pronounced soothing effect. Its application may be direct, the electrode being a relatively large pad applied directly to the affected area, or it may be used in the form of the anodal galvanic bath, the whole limb being immersed. This galvanic bath with a weak solution of quinine has more recently been advocated, but it seemed to have no special value over the ordinary galvanic bath in the two cases which received this treatment. However, in the painful condition of causalgia, where the relief at best may be only temporary, a tepid whirlpool bath is perhaps as soothing as any treatment. In fact, very little progress has been made in the treatment of this condition.

Facial nerve palsies which show an incomplete lesion seem to improve most rapidly, and in some cases this improvement is most striking with the application of negative galvanism. A large pad of the size and shape to roughly correspond to one side of the face is the cathodal or negative electrode, while the anodal or indifferent pole is placed on the back of the neck. A current as strong as the patient can reasonably bear (usually 8 to 15 ma.) is allowed to flow for a period of 20 minutes. This is given daily and is followed by massage of the affected facial muscles. This application of constant galvanism may be applied to any region of the body and has many beneficial effects. It undoubtedly helps to maintain the nutrition of the tissues. It may be given either with the simple electrodes in the form of pads or as a galvanic bath. When combined with faradism, the galvano-faradic method of treatment, we have a form of special nutritional and contractile effect that has many advocates.

Ionization cataphoresis is a form of galvanism whereby elements of certain salts are passed into the tissues for the purposes of lessening pain and "dissolving" fibrous tissues. Potassium iodide, sodium salicylate, sodium chloride, bisulphate of quinine, and cocaine are some of the solutions which are used. It seems, in the experience of the writer, that whatever effect is produced is due to the

effect of the constant galvanic current rather than to the diffusion in the tissues of small amounts of drugs. Theoretical, experimental, and practical work seems to bear this out. It is quite probable that the beneficial effects of this form of ionic medication are due to the action of the electrical currents themselves—i. e., the passage of galvanic currents of low amperage through the tissues results in heat production in the deeper-lying tissues, effecting an increased blood supply and an enhanced cellular activity with marked nutritional benefits. This constant galvanism seems to be of greatest value in tissues which are or have been the seat of a chronic inflammatory process. As previously stated, large pads, well moistened to overcome the resistance of the skin, or the water baths, together with a prolonged application of currents of relatively low amperage, are material factors in the efficiency of its application.

PARAPLEGIA

The treatment of paraplegia cases is fraught with many discouragements both to the patient and the surgeon. This discussion has been placed under this separate paragraph because the treatment of these cases is perhaps more distinctive than that of any peripheral nerve lesion. While the number of gunshot-wound cases with spinal cord injury who survive the initial injury is relatively small, yet each military hospital of the World War had a number of these unfortunate cases. These cases have been bedridden for months, with possibly developed contractures and the inevitable bedsores, so that the return of any voluntary power or sensation is truly a ray of hope to the patient. In those exhibiting signs of regeneration with some recovering function, both sensory and motor, physiotherapy has a very wide and useful field of application. If they are up in a wheel chair so that they may be brought to the physiotherapy clinic, it has been found that a hot tub bath of hypertonic salt solution is of marked benefit. The salt seems to have a very beneficial effect upon the trophically involved skin and serves to keep the ulcers, if present, clean as well as stimulated. Many of these ulcers are very deep and sluggish and are prone to be quite septic. This bath also serves as the ideal preliminary to massage and passive movements, and the hyperemia is more complete than can be obtained from radiant heat and light. If the progress of regeneration continues so that the patient can walk with braces and crutches, special coordinating exercises, walking exercises, and the like produce more beneficial results than any other form of treatment which is available.

HIGH-FREQUENCY CURRENT

The high-frequency current is still another form of electrotherapy which is used in the treatment of nerve injuries. This form of current can be applied directly to the part with vacuum or nonvacuum electrodes—improperly called the violet ray. Heat, surface stimulation, and counterirritation derived therefrom can be used for cases of trophic ulcers, facial palsies, functional paralyses, and disorders of sensation, such as paresthesias, anesthetics, hyperesthesias, and the hysterical types of sensory disturbances. Another form in which this current has a valuable usage is diathermy or thermopenetration. This heat, as the name implies, affects the deeper-lying tissues. Therefore its chief utility lies in the treatment



FIG. 69.—Static treatments

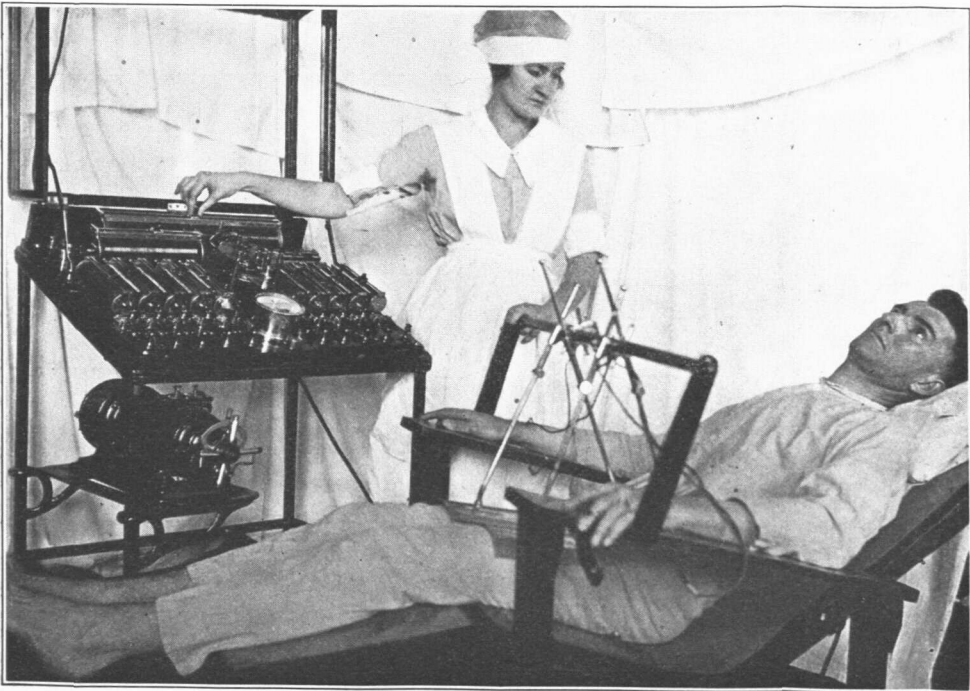


FIG. 70.—Bergonie chair for giving general electric treatments for the psychological effect

of certain types of neuritis, the nonsuppurative inflammations, and in the irritative nerve lesions, as previously mentioned. In the treatment of stiff joints and contracted tendons this deep heat renders the part more amenable to stretching manipulations and like methods. It is of special value in ischemia, in which the increased circulatory exchange will tend to minimize the associated fibrosis.



FIG. 71.—Thermolite

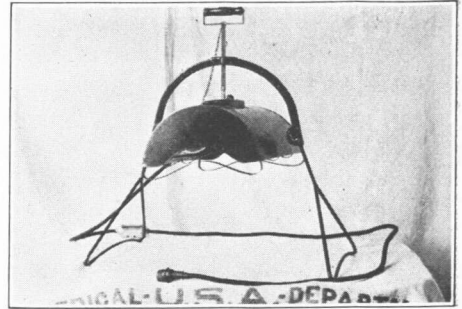


FIG. 72.—Apparatus for applying radiant light and heat to limbs (Burdick, type L4)

STATIC CURRENT

Static currents produced by the static machine have a limited application in the treatment of peripheral nerve injuries. Its currents are of some utility in cases of neuralgic pains, the myalgias, stiff joints, and especially in the psychoneurotic states and functional paralyses.

LOSS OF MUSCLE MEMORY

Some patients with peripheral nerve injuries who have had a group of muscles paralyzed for many months seem to lose the power to transmit the normal motor impulse to the muscles, or the muscles have lost the ability to receive



FIG. 73.—Vibrator, with flexible shaft (Victor)

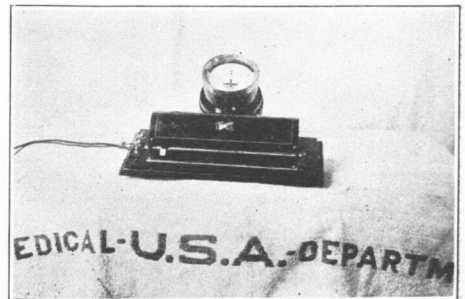


FIG. 74.—Galvanic apparatus, with meter and rheostat (Victor)

it, as manifested by an inability to cause more than a very weak contraction, at best, after the power of faradic contraction has returned. Such cases require the same reeducating exercises as do muscles paralyzed following cerebral injuries.

PARALYSIS FOLLOWING HEAD INJURIES ^c

In the treatment of the neurological complications of head injuries at Walter Reed General Hospital, the first requirement was a thorough study by a

^c Based upon: *The Late Treatment of Gunshot Wounds of the Head*, by Lieut. Col. H. H. Kerr, M. C., *Surgery, Gynecology, and Obstetrics*, Chicago, 1920, xxx, 550-554.

competent neurologist; on the basis of his diagnosis the treatment was prescribed. In the cases of gross spastic paralysis daily massage and splinting were instituted at first, the masseuse being instructed to stretch gradually each contracted muscle. The overstretched extensors were treated by massage and deep transverse percussion. The massage was accomplished by passive exercises, with special attention to extension to overcome the continued flexion. The massage and passive exercises were employed to make possible the voluntary use of the extensors in simple movement. In certain cases voluntary movement could not be obtained for some weeks, but in all cases such movements eventually were brought out. At a very early date the patients were gotten out of bed and urged to walk. During this early period a right-angle-stop splint had to be worn on the ankles to permit locomotion. Crutches and, later, canes

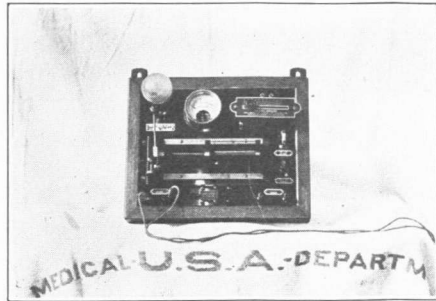


FIG. 75.—Faradic and galvanic apparatus, with meter and rheostat (Wappler)

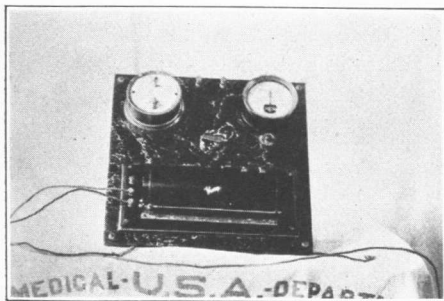


FIG. 76.—Interrupted galvanic apparatus, with meter and rheostat (Victor)

were necessary, but their use was soon discouraged and the patient made to walk by himself, no matter how awkwardly or slowly he did it.

Under such a régime, the bedridden paralytics were soon up and around the wards. The cases were then given re-educative exercises of a competitive nature or in game form. Each movement was considered in the light of its three components—its extent, its force, and its time. The exercises aimed to

produce, first, extent of motion; later, force; and finally, rapidity. When all three had been brought to normal, an accurate motion had been produced. Stepping over a string standard, kicking a basket ball at a target, and dropping a tennis ball into a basket are types of the exercises employed.

The game idea and the sense of competition were made an integral part of the reeducation. To this end, scores were kept of the different exercises and games in which the patients took part. For instance, a man's ability to stretch his arm up the wall, or to release a tennis ball into a basket a certain number of times in a given time, was measured from day to day and compared to like efforts of his fellow patients. A game of baseball was played every day by all the patients together. It was most interesting to watch one of these games. No matter

Under such a régime, the bedridden paralytics were soon up and around the wards. The cases were then given re-educative exercises of a competitive nature or in game form. Each movement was considered in the light of its three components—its extent, its force, and its time. The exercises aimed to

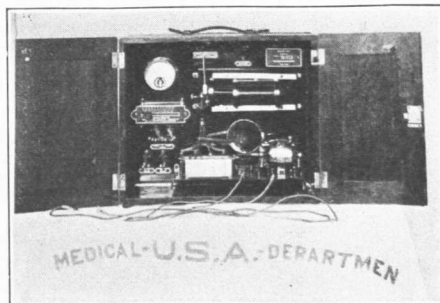


FIG. 77.—Galvanic and slow sinusoidal apparatus, with meter and rheostat (Wappler)

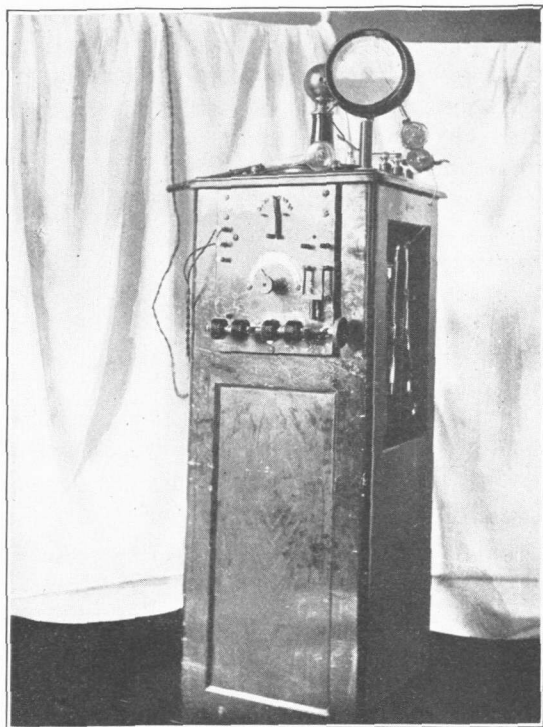


FIG. 78.—High-frequency apparatus (Victor)

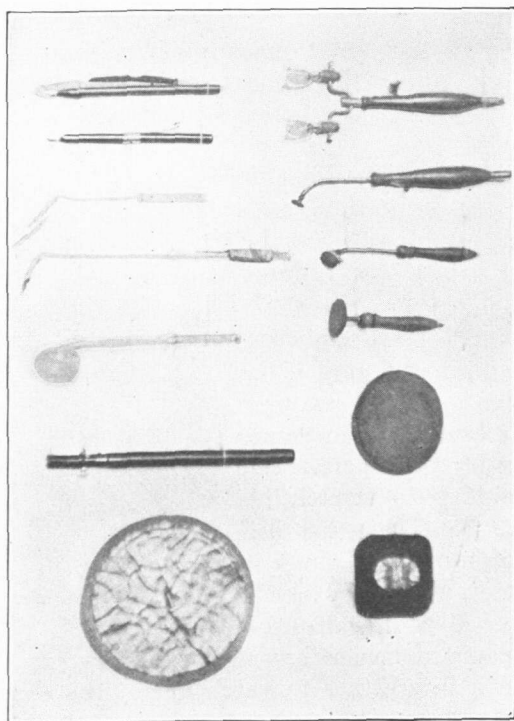


FIG. 79.—Electrodes

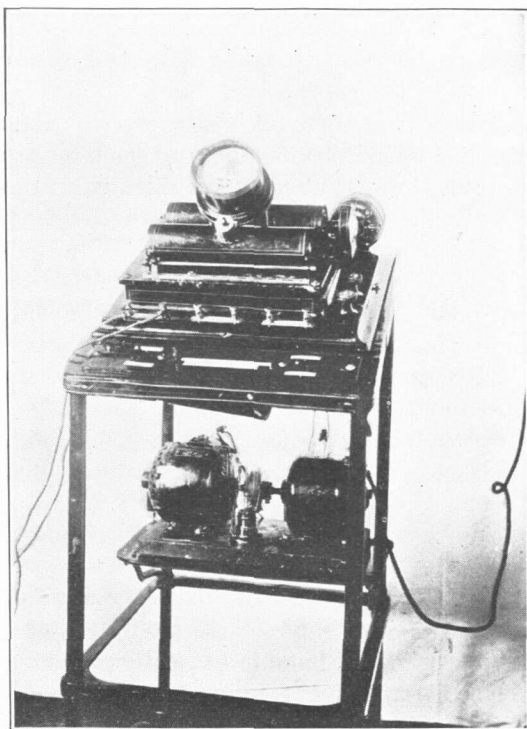


FIG. 80.—Galvanic and sinusoidal apparatus, mounted with motor generator (Victor)

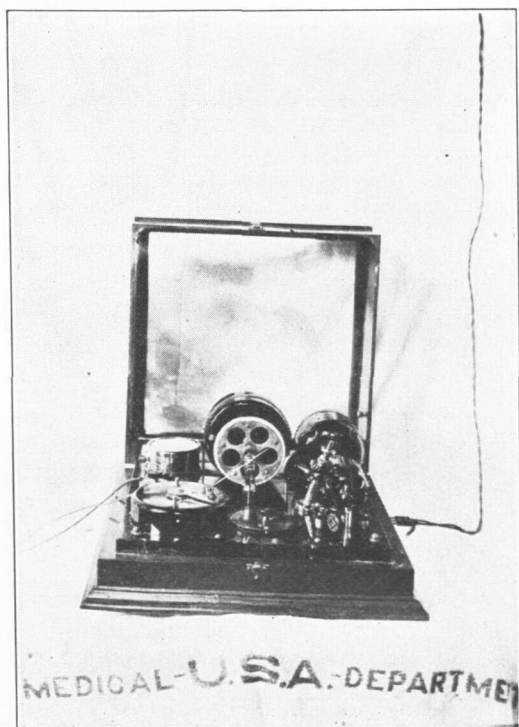


FIG. 81.—Apparatus, polysine, for galvanic and sinusoidal currents (McIntosh)

how awkwardly a motion might be performed, under the stimulus of the game they somehow seemed to be able to make hits and score runs, apparently forgetting their disability in the effort.

In addition to the scores of their exercises, each patient was measured as to his extent, strength, and speed of movement at least once a fortnight. The results of these measurements were charted graphically and tacked to the wall, where each patient could see not only his own progress but also the progress of his fellow patients. In addition to the moral stimulus that these charts gave the patient himself, they were an invaluable guide to the therapy. Thus particular attention was paid to that movement which showed the least improvement. In this way one group of muscles was brought back toward normal as soon as another, and substitution of movement did not occur. With improvement, exercises which educated, the time and the accuracy of each movement were instituted. When the patient could grasp a pencil he was made to practice drawing a circle, then a square, and thus gradually was taught to write again.

Cases with gross defects and destruction of the motor cortex gradually acquired all the movements which they had lost. An experience with a large number of cases of cerebral paralysis most strikingly demonstrates that much more can be done for these cases than is commonly supposed. With proper appreciation of this fact, we should be able to reeducate each case of traumatic cortical injury to a degree of practically no permanent disability.

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- (2) Ibid, 1164, 1166.
- (3) Ibid, 1096.
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- (5) Miramond de Laroquette: Actions des bains de lumière naturelle et artificielle. Archives d'électricité médicale expérimentales et cliniques, Bordeaux, 1912, xxi, 82-97.

CHAPTER V

IN HOSPITALS CARING FOR THE MENTALLY DISABLED

Investigations concerning the future policy of the Medical Department in the care of the mentally disabled were initiated in May, 1917, when the chairman of a subcommittee of the National Committee for Mental Hygiene visited Canada to ascertain the methods employed in the Canadian Army.¹ The report of his investigation indicated that 12 per cent of all disabled returning from overseas would be classified as nervous and mental disease; that one-half of these would be war neuroses, one-fourth mental disease, one-seventh head injuries with nervous symptoms, and one-tenth various neurotic conditions, and that a ratio could be expected of something over 13 nervous and mental cases from every 1,000 troops in home territory.

The report further indicated that segregation should be made not only of this class as a whole from other classes of disabled but also men with war neuroses from the insane. This segregation was very advisable for two reasons: The whole class of mental diseases and defects required more individual attention in vocational training than those with normal nervous systems; men with war neuroses were inclined to be faultfinders and troublemakers, and a few cases in a general institution would corrupt the general morale and make vocational training particularly difficult. The value of vocational training for this general class of disabled was emphasized.

Further investigations along the same lines were made in December, 1917.² The findings of these investigations coincided approximately with those of the previous spring; however, the following four points in the care of war neuroses were emphasized: (a) The maintenance of military discipline and individualized control was indispensable and of first-rate importance in dealing with these cases; (b) hydro- and electrotherapeutic treatment was considered of great service in many cases; (c) occupation therapy with suitable variety of work was of almost universal importance; (d) in the general policy of caring for the war neuroses it had been demonstrated over and over again that patients while under treatment should be shifted as little as possible from one institution to another.

The study of foreign experiences in handling mental cases showed that the work fell into two main divisions—the care of those with functional derangements, the neuroses, and those with organic derangements, principally the insane and those congenitally defective.² The methods used were radically different. The neuroses, being largely under the control of the will, required a brief period of rest, encouragement, and reassurance, carried out on or near the front, with an absolute separation from the outset the idea in the mind of the soldiers that the condition was of disabling and pensionable character.³

Neuroses were common during the World War among soldiers with a nervous instability which unfortunately became widely known under the entirely

misleading term of "shell shock." The general conception of the public as to the meaning of this term was that it applied only to persons whose nervous mechanisms had been so racked by the concussion of high-explosive shells in their immediate vicinity that they could no longer quietly withstand the impacts on their nervous systems from trivial noises, sudden movements, etc., occurring in their neighborhood. As the active factor usually attributed to the etiology of this condition, shell explosions, was seldom an actual factor, the acute onset of the condition occurring elsewhere than in the front lines in the great majority of cases, it was an early decision that the term "shell shock" had no place in the medical nomenclature. Such cases consisting merely of the more or less sudden manifestation of the inadequate stability of their nervous systems with which they were born, induced by the unaccustomed strains of military life, it was very properly directed that they be classed as psychoneurotics.⁴ The symptoms of which these patients complained had unlimited range—extreme restlessness, extreme susceptibility to sudden noises, convulsive contractures, mutism, deafness, and all other varieties of hysterical symptoms. These cases were not ordinarily given physical reconstruction, as by the time this service was organized other methods of treatment had been found so efficacious that the majority of cases were returned to duty. However, when a case of this nature had been in hospital a long time it was most stubborn in yielding to treatment. On the other hand, patients who had psychoses would never be of use to the Army and required control of their various episodes, with ultimate discharge to friends or to institutions.

Early provision had been made by the Surgeon General for the care of patients with temporary mental derangements in most base hospitals, for the care of epileptics and functional neurotics in special hospitals, and for the care of the insane in special wards at Walter Reed General Hospital, Washington, D. C., Fort McPherson, Ga., Fort Sam Houston, Tex., Fort Des Moines, Iowa, Letterman General Hospital, San Francisco, Calif., General Hospital No. 4, Fort Porter, N. Y., St. Elizabeths Hospital for the Insane, Washington, D. C., and possibly in authorized public institutions.⁵ An elaboration of this list directed that, pending the establishment of special hospitals, cases would be collected as follows:⁶ Functional neuroses and epileptics at Fort Riley, Kans., and General Hospital No. 9, Lakewood, N. J.; epileptics needing surgical treatment at General Hospital No. 11, Cape May, N. J. A further modification directed that mental cases in which recovery seemed to be improbable be sent to either St. Elizabeths, Washington, D. C., Mendocino State Hospital, Calif., or Fort Crook, Nebr., the choice to be determined by the proximity to the soldier's home.⁷

Special hospitals were later established at Fort Porter, N. Y., Dansville, N. Y., and East Norfolk, Mass.; special beds for officers at Bloomingdale Hospital in connection with General Hospital No. 1, New York, and special wards at Walter Reed General Hospital, Washington, D. C., Fort McPherson, Ga., Fort Sheridan, Ill., Fort Benjamin Harrison, Ind., Letterman General Hospital, San Francisco, Calif., Fort Sam Houston, Tex., and Madison Barracks, N. Y.⁸ All patients presenting symptoms of insanity, except those who seemed incurable, were to be held in the special wards of military hospitals for not

over four months; those who recovered within this period were to be discharged for physical disability; those who did not recover were to be transferred to St. Elizabeths Hospital.⁸

General Hospital No. 30, Plattsburg Barracks, N. Y., had been designated to care for patients suffering from functional nervous disorders.⁹ This specialization was not adhered to in sending cases there, with a resultant interference with successful treatment of the functional neuroses. In November, 1918, 48 per cent of all admissions were epileptics, 10 per cent mental defectives, 2 per cent demented, 1 per cent manic depressives, and 1 per cent general paresics.⁹ This state of affairs led to a study of conditions and report by a board of officers as follows:¹⁰

As a result of our observation and study in United States Army General Hospital No. 30 of returned soldiers suffering from curable functional nervous diseases we have come to the following conclusions:

1. Many soldiers, whether they have been on duty in this country or returned from France, suffering from these nervous disorders, have the idea fairly well fixed that they are incurable and should be discharged. Some are already endeavoring to establish a claim for compensation, and it may be confidently anticipated that the numbers of such will greatly increase.

2. Our experience and that of other physicians in this country and in England, France, and Italy shows that a great majority of these patients can be cured.

3. We are of the opinion that no soldier suffering from this form of disease incurred in line of duty should be discharged from the service. They should be retained under the control of the Medical Department until they are cured.

4. It is evident that unless this plan is adopted a large number of soldiers will be made into pensioned, languishing invalids instead of self-supporting and self-respecting individuals. The amount of money needed for the payment of pensions for such discharged soldiers would be a continuous financial drain for many years.

5. The Surgeon General has established in United States Army General Hospital No. 30, Plattsburg, N. Y., a general hospital of 1,000 beds for the exclusive treatment of curable functional nervous diseases. Similar hospitals will have to be established in other parts of the country, for it is estimated that in a short time many such patients will be returned to this country.

6. Experience in this hospital since its organization has most emphatically shown that the methods of treatment now employed for war neuroses are burdened with the serious drawback of encouraging the idea of invalidism and in many cases of preventing cure. These patients are constantly appealing to their relatives and friends, and some even to their political representatives, to be discharged from the service on the ground that further hospital treatment will do them no good.

7. The accumulated experience of this war has proved beyond any doubt that the treatment of military functional nervous patients must be carried out under strict military discipline. Hospitalization of these patients makes the task hopeless and impossible.

8. The success of such a hospital depends in large part upon its reputation for cure. When a soldier is ordered to such an institution it should be of general knowledge not only to him but to the public at large that he is ordered to a place where cure is certain and not to a hospital where incurables are received.

9. We recommend that there should be established in conjunction with United States Army General Hospital No. 30 a training camp to be known as the Plattsburg Training Camp. Soldiers, when they are sent to Plattsburg, should be ordered to report to the training camp. If they are found to require hospital treatment they will be transferred to the general hospital.

10. It is evident that the success of such a plan would depend very largely upon the proper selection of suitable cases. Incurable patients, such as epileptics, insane and others, should not be sent there. If, by some mistake, they are sent to Plattsburg, authority should be granted for the prompt transfer of such cases.

11. The plan of the camp management, treatment, and methods to be employed should be along lines of healthful suggestion, with the employment of all sorts of gainful occupations, drills and constructive work of various kinds, under military discipline. A number of officers and noncommissioned officers will be needed, and they should be selected from amongst those who have been successfully treated in this institution.

12. In order to assist in determining the number of soldiers for whom provision would have to be made in such a camp it is estimated that the average residence would be one or two months. At the end of such period the majority of soldiers would be ready for duty.

13. The management of such a camp should be under the exclusive direction of the Medical Department.

14. The importance of the proper management and care of this class of patients can not be overestimated. All of our allies have found this problem particularly difficult of satisfactory solution. The plan laid out above and respectfully submitted, we believe, will furnish as satisfactory a solution as can be offered, and we strongly urge the immediate adoption of such a plan for United States Army General Hospital No. 30 and the construction of similar hospitals in other parts of the country.

A visiting consultant agreed with these conclusions,⁹ and also stated that a large proportion of the patients showed hereditary taint, and the difficulties of a disciplinary sort and of treatment alike were increased by the readiness of relatives with similar tendencies to encourage the patient in his faulty attitudes and to enlist the services of Senators and Representatives in the effort to obtain an early discharge from the Army. He also stated that the conditions as outlined bore directly upon the work of physical reconstruction in all its phases and affected it to a degree deplorably adverse to the desired results. This plan for a "reconstruction detachment of patients" was not approved, but the epileptics and insane were removed.¹¹

Instructions were issued in April, 1919, that cases in which recovery was considered improbable after four months' hospital treatment, or which would require a much longer period of hospital treatment to effect a cure, would be transferred to such institution as was designated by the Bureau of War Risk Insurance and discharged on certificate of disability.¹²

Each cantonment base hospital was provided with one or more neuropsychiatric wards, which were especially designed and equipped to care for nervous and mental cases for a short period, after which time they were discharged, or, if necessary, transferred to one of the general hospitals which had adequate facilities for the continued treatment of such cases.¹³

In order to provide for the disposition of mental cases which could not be given continued treatment in the psychiatric ward of the cantonment base hospitals, special neuropsychiatric services were established at the following places:¹³ General Hospital No. 1, including Messiah Home, Bloomingdale Hospital (officers only); General Hospital No. 2 (officers only), including Shepherd and Enoch Pratt Hospital (nurses only); General Hospital No. 4, exclusively for mental cases; General Hospital No. 6; General Hospital No. 13, exclusively for mental cases; General Hospital No. 25; General Hospital No. 26; General Hospital No. 28; General Hospital No. 30, exclusively for cases of psychoneuroses; General Hospital No. 34, exclusively for mental cases; General Hospital No. 43, exclusively for mental cases.

With the exception of General Hospitals Nos. 4, 30, 34, and 43, the special neuropsychiatric services were established in these hospitals, first, because they would reduce transportation to the minimum in providing facilities near all

camps; second, because they would enable all cases to be treated in the vicinity of their homes; third, the system was the most economical utilization of the existing facilities.¹³

General Hospital No. 4 was devoted almost entirely to cases of insanity returned from American Expeditionary Forces.¹³ Because the bed capacity was soon taken up, it was necessary for General Hospitals Nos. 13 and 34 to be taken over for the care of insane cases.¹³ As the number of cases returned from abroad decreased and the population of these hospitals diminished, all the cases were transferred to the Soldiers' Home for Disabled Volunteer Soldiers, Hampton, Va., which previously had been Debarkation Hospital No. 51.¹³ On May 1, 1919, it was made General Hospital No. 43 for the care and treatment of mental cases. At the time of the transfer of these cases General Hospitals Nos. 13 and 34 were closed.¹³

This change proved very satisfactory because all cases of insanity were now returned from American Expeditionary Forces through the port of debarkation at Newport News, Va., and taken directly to the hospital without long travel, and economy of personnel resulted, as the patients were now treated in one hospital instead of three.¹³ The home was very suitable for the treatment of mental cases. There every facility for the modern care and treatment of insane was provided, the hospital being staffed with highly trained specialists, experienced attendants, nurses, and reconstruction aides.

General Hospital No. 30 was established especially for the treatment of cases of psychoneuroses.¹³ Most of the cases treated there were returned from American Expeditionary Forces. This hospital was a decided success, as evidenced by the fact that cases of this class, which were a source of so much trouble to other countries, were handled without any unusual difficulty.¹³

Cases were transferred to and from these hospitals by attendants experienced in the transportation of insane and neurotics.¹³ Reports of the elopement of patients and injuries received while in transit were few, and complaints as to condition of patients arriving were almost negligible.¹³

The patients were treated in these centers for periods of at least four months unless cured, or there was special reason for their disposition earlier.¹³ In this manner Army regulations governing the disposition of the insane were not resorted to until satisfactory period of observation and treatment had elapsed.

Cases which did not recover in four months and which required treatment for an indefinite period were turned over to the War Risk Insurance Bureau.¹³ Arrangements were made for the transfer in such a manner that there was no interval between discharge from the military service and the commencement of the continued care in hospitals near their home provided by the bureau.

On June 25, 1919, 2,859 cases were under treatment in military hospitals.¹⁴ Of these, 1,648 had psychoses, 470 psychoneuroses, 165 were constitutional psychopaths, 238 had mental deficiency, and 89 were epileptics. By August 12, 1919, 8,319 mental cases had been returned from overseas, and 2,210 cases remained under treatment in the following military hospitals: ¹⁵

Special hospitals:

General Hospital No. 4, Fort Porter, N. Y.....	194
General Hospital No. 43, Hampton, Va.....	1, 087

Special wards in other hospitals:

Walter Reed General Hospital, Washington, D. C.....	123
Letterman General Hospital, San Francisco, Calif.....	80
General Hospital No. 1, Williamsbridge, N. Y.....	40
General Hospital No. 2, Fort McHenry, Md.....	47
General Hospital No. 6, Fort McPherson, Ga.....	132
General Hospital No. 24, Fort Benjamin Harrison, Ind.....	178
General Hospital No. 26, Fort Des Moines, Iowa.....	95
General Hospital No. 28, Fort Sheridan, Ill.....	117
Base Hospital, Fort Sam Houston, Tex.....	117

These cases were classified as follows: Insanity 1,447; psychoneuroses, 349; epilepsy, 64; constitutional psychopathic states, 156; and mental deficiency, 194.

When the question of reconstruction in neuropsychiatric hospitals first was taken up the feasibility of introducing such procedures generally into the neuropsychiatric wards was doubted; reconstruction was considered to be applicable only to those cases which were less disturbed mentally.¹⁶ However, after several months' experience in neuropsychiatric hospitals the benefits of occupational therapy became so pronounced and the aides so skillful in their approach that the work was given to all neuropsychiatric patients except the extremely violent.¹⁶ This furnished systematic employment to restless patients, reduced the introspection of neurotics and the delusions of the insane, seemed to shorten the duration of the præcox or manic episode of the psychoses, and decreased the necessity for restraint in the more disturbed cases.

RECONSTRUCTION WORK, GENERAL HOSPITAL NO. 2, BALTIMORE, MD.

The following account of the activities of the neuropsychiatric department General Hospital No. 2, Fort McHenry, gives a very good idea of the way in which neuropsychiatric cases generally were cared for:¹⁷

The care of the patients was accomplished without any of the old-time methods of iron-barred windows and grated doors. The interior of the building was decorated and painted in soft restful colors, while potted plants and flowers distributed throughout and lace curtains at the windows all combined to make the place as attractive, homelike, and pleasant as possible. In the rear a spacious porch had been converted into a solarium and made an ideal place for the occupational therapy activities. The building had its own hydrotherapeutic plant, and the soothing effect of the sedative bath, especially in maniacal cases, was successfully demonstrated many times. Full advantage was taken also of the hospital's physiotherapy department, and nearly all of the neuropsychiatric patients were sent daily for some kind of treatment in the more elaborately equipped department.

No effort was spared to provide every therapeutic benefit to be derived from diversional occupation and recreation for the patients. A reconstruction aide spent her time entirely with them, doing all that was possible to keep their minds and hands busy, and splendid results were achieved. In addition to this occupational therapy, a teacher of calisthenics spent some time each day giving the patients brisk exercises—lively games, which were greatly enjoyed. A large pool table, a Victrola, and a well-stocked library, all donations of interested friends, were available for use at all times. The fundamental principles underlying the treatment of the patients were the use of psychotherapy, hydrotherapy, and occupational therapy. The patients were treated individually and not collectively. No routine or system methods were used in administering to those who were admitted complaining of the many

and varied symptoms incident to a nervous or mental disorder. The satisfactory results attending the use of these three important agencies, especially in the large group of functional neuroses and the incident mental disorders, amply justified the principles of nonrestraint which were insisted upon.

In the treatment of nervous and mental disorders occupation and recreation were of paramount importance. An occupational aide who had the happy faculty of exciting interest in a catatonic præcox, of arousing the interest of a patient in the depressed phase of a manic-depressive psychosis, of directing the useful and constructive channels the hyperactivity of a maniac, or who might be able to replace the obsessive idea of a psychasthenic with a healthy, helpful, and interested thought, certainly accomplished a great deal toward the recovery of such a patient. The first occupational aide was assigned to the neuropsychiatric ward, and it was not without some misgivings that additional aides were sent throughout the hospital. It had been demonstrated that occupational therapy had a very definite mission to perform, not only in Army hospitals but in civil hospitals as well. The sun parlor, where basketry, beadwork, and various other light crafts were carried on, and the carpenter shop where willow and reed work, carpentry, painting, modeling and numerous other handicrafts were being constantly indulged in, were the most inspiring and interesting parts of the work.

A special feature was made of recreation. Several times a week afternoon parties were given for the patients, with music and refreshments, and the various holidays were celebrated by proper decorations and games.

Excellent results which were accomplished by sending patients to a river camp for convalescent soldiers. The recovery of a number of patients dated from the time they spent at this delightful summer camp, where boating, swimming, fishing, and many other outdoor sports were available. This camp was especially beneficial in allowing the patients the opportunity of getting away from the routine of hospital life and feeling the freedom and stimulating effects of the outdoors.

PSYCHOLOGICAL STUDIES, GENERAL HOSPITAL NO. 30, PLATTSBURG, N. Y.

The results of the following psychological studies made at General Hospital No. 30 are of interest in connection with the reconstruction of patients suffering from psychoneuroses. When the schooling and mental ages of the patients are considered in connection with their neuropsychiatric conditions, the reason for the predominance of the occupational and simpler academic activities is very apparent.

Of 836 neuropsychiatric patients discharged from the Army during the World War, the psychiatric survey showed their schooling to be as follows: 375 had seventh-grade education or less, 130 had eighth grade, 93 had incomplete high school, 30 had completed high school, 51 had one or more years in college, and in 151 the education was undetermined.¹⁸ On the basis of rank, there were 703 privates, 26 privates first class, 54 corporals, 27 sergeants, 4 sergeants first class, 6 second lieutenants, 14 first lieutenants, 2 captains, 2 majors, and 1 colonel.¹⁸

The mental ages of the first 1,173 patients who were given the psychological examination are shown in Table 12. The limit of feeble-mindedness in adults is variously placed at 10 to 12 years, and the average mental age of soldiers in the recruiting camps was 14 years.¹⁹ On the basis of 10 years, the table indicates that approximately 25 per cent of these men had defects of intelligence as well as their obvious character defects.

If 12 years be accepted as the limit, then almost 50 per cent of these men had less than a normal intelligence. Sixty-four per cent were below the average of 14 years found in the camps.

The manner of utilizing the results of psychological surveys in the selection of work for individuals at General Hospital No. 30 is illustrated by the following cases:²⁰

CASE 1.—Diagnosis, convalescent cerebrospinal meningitis, with mild residual symptoms—stiffness, chill, headache. Age, 24. Education, technical engineering school.

Make-up.—Intelligence quotient, 110. Active and progressive attitude. Spontaneous interest in vocational activity related to previous work. Competent personality, well balanced, with no psychoneurotic tendencies manifest. Meningitis incurred in line of duty. Recovery well under way. Probable stay in hospital not over six weeks. Probable condition when discharged from hospital, recovered.

Assignment.—Work in mechanical drawing and drafting for occupational as well as vocational purposes.

Functional end.—Activity and distraction from symptoms as well as satisfaction of ambition toward self improvement.

Progress.—Excellent. Skill acquired, high grade. Expressed desire to transfer to educational service or go to an officers' training school.

Disposition.—Discharged from hospital to training camp for officers in Engineering Corps, recovered; to full duty. This transfer was facilitated by the discovery of his high intelligence quotient in the psychological laboratory.

CASE 2.—Diagnosis, hysteric hemiplegia. Contracture of left arm. Age, 25. Education, grades only.

Make-up.—Mental age of 12 years. Shows, however, special aptitude in learning tests with concrete tasks. No ability for abstract thinking. Attitude self-centered and introspective, both docile and cooperative.

Occupation.—Butter maker, from which work his present and probable future condition incapacitates him, since his symptoms are intensified by cold and damp conditions.

Probable condition on discharge.—Relief from acute symptoms, with liability to recurrence except under favorable circumstances.

Assignment.—Physiotherapy for restoration of hemiplegia. Vocational work, in order to permit him to change his occupation on return to civil life and to fit him for limited service in Army. Took up bookkeeping and commercial arithmetic so as to become clerk or inspector in creamery, with which he is familiar in all branches.

Progress.—Works faithfully, making slow progress because of inadequate native capacity. Symptoms much relieved and he becomes hopeful and relatively ambitious to reenter service.

Disposition.—After recovery discharged to limited service in Quartermaster Department.

CASE 3.—Psychasthenia on background of infantile personality. Age, 26. Education, grades and lower high school.

Occupation.—Postmaster in small town and grocery clerk, both as helper to his uncle.

Make-up.—Average adult performance in tests. Attitude introspective, evasive, and whimpering. Talks "papa and mama" and displays inability to "get away from the family," "mother complex," masturbatory fancies and dreams. Complains of inadequacy and inability to see life correctly. Does not think he can ever get well.

Probable condition on discharge.—Much the same as now.

Assignment.—Work as assistant to physicians and psychologist, in endeavor to get him interested in other's welfare, thus breaking up his morbid hypochondria and egocentric trend. Psychoanalysis and conference with psychologist. Finally, vigorous work in carpenter shop as assistant to foreman.

Progress.—None noted in several months. Takes to his bed whenever vigorous work is prescribed, with vague and organically unjustified complaints.

Disposition.—Still in hospital; little gain shown.

CASE 4.—Diagnosis, emotional trauma (shell shock), with speech disturbances, tremor, excitability, and violent contortions at unexpected sound. Age, 30. Education, neglected, grades only.

Make-up.—Affable and willing, but unable to stand the mild strain of mental tests. Repeats everything said three times. Goes into violent trembling and fear reaction at such noises as hammering, whistling, or being suddenly spoken to. Wants to recover.

History.—Blown over by shell explosion at the Marne and buried for 16 hours without food or drink. Lost consciousness when recovered and subsequently showed present symptoms.

Probable condition after recovery.—Will probably recover to at least his previous condition before service, which was probably characterized by neurotic predisposition, tendency to stammer, etc.

Assignment.—Invalid occupation in quiet room working at basketry and light desultory work. Occasional opportunity to get accustomed to noise which he himself makes, then to noises the nature of which he fully understands, and finally to general work.

Progress.—Has already improved so that he is steady enough to do creditable work in basketry, to walk on the road with his face toward coming traffic, and even to take an occasional ride in a noisy automobile. Speech disturbance still remains and general attitude of fear still apparent. Tremors clearly reduced.

Disposition.—Still under treatment.

CASE 5.—Diagnosis, epilepsy. The treatment of epilepsy presents many special problems in occupational therapy. For instance, irritation in an epileptic requires very special handling, entirely different from that of normal, hysterical, or depressive pupils. Age, 24. Education, can neither read nor write.

Assignment.—Mechanical drawing, English, arithmetic.

History.—Machine-shop worker for Georgia Southern Railroad. Will return to old work when discharged. Psychological record shows traits characteristic of epilepsy. Reasons for nature of assignment: (1) Necessary physical exercise therein provided for; this determined previous to assignment; (2) ambition to read and write worthy one and psychological tests showed that it could be realized; (3) ability to use simple arithmetic to read blue prints of direct vocational value; (4) vocational training is the best therapy in cases like this.

COURSES OF INSTRUCTION

At General Hospital No. 13 courses were given in bench woodwork, carpentry, painting and staining, machine work, pattern making, automobile mechanics, English, arithmetic, bookkeeping, stenography, typewriting, drafting and designing, geography, agriculture, history, economics, weaving, basketry, printing, lettering, and poster making.²¹ Frequent entertainments of various kinds were given, with an effort to have the patients put on their own shows, and a band was organized. One hospital, General Hospital No. 30, Plattsburg Barracks, N. Y., maintained an excellent library of nearly 4,000 volumes, with the leading periodicals and newspapers from the principal cities of the country.²² The library was considered to have been an important factor in the reconstruction work.

VALUE OF RECONSTRUCTION

Though the recorded statements concerning the value of reconstruction work in the treatment of functional neuroses may not appear to be as enthusiastic in its support as those dealing with other types of mental disease, this is probably due to the fact that good results were more generally expected in the functional neuroses.

At General Hospital No. 30 a part of the cure of functional neuroses was, so to speak, to wear the patients out by paying no attention to their complaints, many of them finally concluding that they would not get a discharge with the expected disability allowance, and therefore recovered.²³ Thus, with very

little active medical work being done, work in the educational service provided a valuable outlet for their excess energy, and their average stay of 29 days in that hospital provided an unusually favorable opportunity for this work to be sufficiently extensive to be of real value to most of the patients. On the other hand, many materially benefited from the instruction given; the employment was an important factor in the maintenance of morale, and the results fully justified the expense and efforts of the Government in maintaining the service.¹⁸

The beneficial results of reconstruction as a whole when applied to neuro-psychiatric patients were reported by the commanding officer, General Hospital No. 43, as follows:²⁴

The continuous sedative bath, hot packs, Scotch douches, needle showers, electrical heat, occupational therapy, and exercise were the chief modes of treatment. Continuous baths were installed in three buildings for the treatment of excitable cases who required frequent and rather long-continued baths to control their psychotic episodes. There were no instances where a patient could not be quieted by the use of the hot pack or continuous bath if the patient was handled judiciously and the treatment repeated at frequent intervals. The patients seldom objected to these treatments and many were glad to return to the baths.

Occupational therapy did much to establish confidence on the part of the patient. The helpless and irresponsible patients were coaxed to work on the wards, beginning with simple tasks, such as the winding of string, the unraveling of burlap, basketry, rug weaving, knitting, etc. As the patient regained his confidence and the control of his faculties and acquired more responsibility, he was allowed to do a different class of work requiring more physical and mental ability, such as carpenter work, printing, typewriting, and automobile repairing.

Exercise and recreation were supplied through the medium of walks for the responsible patients, varied calisthenic movements for the others; automobile rides were provided through the American Red Cross and other civilian agencies.

The commanding officer, base hospital, Fort Sam Houston, Tex., reported:²⁵

Prior to the establishment of this work among the mental and nervous cases of this hospital it was practically impossible to avoid placing the patients who were in the department in an enforced state of idleness. It is a natural consequence that idle insane patients are prone to continual self-analysis and elaboration of delusions. Likewise, unoccupied, the cases of precocious dementia are very prone to mental deterioration. With the advent of the industrial pursuits and the presence of the reconstruction aides in daily attendance among the patients, there is a noticeable improvement, a lessened tendency toward excitement or seclusiveness. In general, it may be said that, together with calisthenics and hydrotherapy, the reeducational effort has brought about a rare spirit of contentment among these unfortunate people, and we are inspired by the hope that recoveries, as evidenced by universal improvement, will occur in a great majority of the patients. I regard the work that you are having done in this department as being probably the most valuable single therapeutic agent.

The following conclusions reached by the officer in charge of the physiotherapy department, General Hospital No. 30,¹⁹ may help to explain some cases which were attributed to the increased strain of the war period:

Experience definitely demonstrated the bad effects of a sustained strain of modern warfare on the vagatonic and sympathetic nervous systems in cases showing functional disturbances of the endocrine glands.

A large group of cases manifested a depleted adrenaline system, with the development of a compensatory hyperthyroidism. The various symptoms, such as headache, insomnia, fine tremors, rapid pulse, incoordination, low-blood pressure, fatigability, irritability, taciturnity, etc., responded best to the higher temperatures in thermotherapy, in an average temperature of 350° F., in gas

and electric ovens, followed by modified pack, shower, and spinal douche, alternating daily with autocondensation or sinusoidal currents to spine.

Further, a number of cases showed evidence of more or less toxemia, either systematic or due to local foci of infection, the latter usually found in the mouth, and over 50 per cent of which were found to be due to infections in roots of teeth or gums. Another large group was also traceable to infected tonsils.

General elimination of these toxic products was facilitated by physiotherapy. It was essential that the local foci be removed also.

SOCIAL-SERVICE WORK

The social-service work was also of value along lines somewhat similar to the psychologic, but more so as an aid in the diagnosis, classification, disposition, and aftercare through intimate touch with the individual patient, his past history, and future environment.¹⁶

An account of the social service as carried on at General Hospital No. 30 will serve to show how this work generally was conducted.¹⁹ This service was established September 1, 1918, upon the arrival of one social-service worker furnished by the American Red Cross, the primary demand for such service being due to the very incomplete medical records accompanying many patients, particularly those from overseas. Some patients presented symptoms which indicated that their conditions had existed for many years prior to their entry into the military service, but there was no direct evidence to support this view. Others arrived with a diagnosis only, as "epilepsy," presenting no symptoms of such disease while in the hospital. It was obvious that an early personal history of such cases obtained from relatives, employers, family physicians, etc., would be of great value, not only in determining an accurate diagnosis but in protecting the rights of both the patients and the Government when claims for compensation were filed.

The work gradually developed into four divisions—(1) securing early histories, (2) social case work, (3) aftercare, and (4) administrative work.¹⁹

The object sought in the majority of the investigations was the establishment of the period in life in which the disease originated, in order to decide the question of the Government's liability and the soldier's rights regarding compensation.¹⁹ The patient was questioned as to his previous history, special emphasis being placed on the securing of names and addresses of individuals who would be in a position to give the necessary information. Replies were received to 90 per cent of the inquiries, the greatest assistance coming from physicians and former employers. It developed that the disease itself, or a nervous instability, had existed prior to Army Service in the majority of cases, and in some cases that the patients' statements were deliberately untruthful. Such results were to be expected in this particular class of cases, especially when the patient was malingering in an effort to secure compensation or to avoid military service.

These investigations were so successful that it was desired, as a routine, to refer all overseas cases to this service, but the large number returning after the armistice began permitted the reference of only those in which such information was felt to be essential.¹⁹

Assistance rendered to soldiers who were troubled by personal or family difficulties was one of the most important results of the social service.¹⁹ The chief source of this type of work was the failure to pay allotments made by soldiers for the financial support of relatives, particularly the compulsory family allotments. The soldiers' statements concerning nonpayment almost invariably were found to be correct, but in general the soldiers were grossly ignorant concerning the Bureau of War Risk Insurance and its methods of operation.¹⁹

Another phase of the social case work which was of particular importance was the personal talks with the soldiers who came for assistance.¹⁹ The majority of the cases treated showed mental inferiority and moral defects. Thefts of their personal property, nonpayment of allotments, etc., resulted in a feeling on their part that the protection afforded to them in civil life had not been given to them in their military life, and their main aims were to "get something" from the Government and to be discharged as soon as possible. The social workers made a special effort to give these men a somewhat different point of view regarding the military system.¹⁹

Attention to the welfare of psychiatric cases after discharge from the Army for disability was particularly necessary, owing to both the character of their disabilities and the probability of their not being entitled to compensation, the diseases having existed before their entry into the military service.¹⁹ The social worker referred such cases to the American Red Cross when their discharges were recommended, and the Red Cross immediately had reports made as to their home conditions and received notice when the men were discharged. Such assistance as was indicated was then rendered—financial, medical, supervision, securing employment, etc.

Frequently the social service was called upon by the hospital administration to reply to letters from friends and relatives of patients who desired information concerning the patient's condition, surroundings, etc.¹⁹ These replies required careful consideration, for they must contain sufficient information to allay anxiety, and at the same time they must not divulge information which might give a false impression or serve as a basis of a claim against the Government.

Such questions as the need for furloughs, when the reliability of the statements was questioned, and the need for early discharge from the Army because of dependency or serious illness of relatives, were referred to the service.

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CHAPTER VI

IN HOSPITALS CARING FOR THE BLIND

The early plans formulated in the division of special hospitals and physical reconstruction of the Surgeon General's Office, which were unanimously approved by a committee of prominent educators of the blind, were as follows: ¹

1. *Definition.*—Blindness means no vision, or too limited vision to do work for which eyesight is essential.

2. *The work in France.*—

(a) The establishment of a special hospital center to which all blinded men would be sent.

(b) No soldier to be classed as blind except by the surgeon in charge at this center.

(c) An executive officer at the center, to be responsible for the professional and teaching staff for the blind.

(d) Recreation and occupation for the patient to be inaugurated in the base hospital as early as practicable and continued to the time of debarkation in the United States.

(e) Blinded men should be distributed among other patients to broaden their interests, to secure the assistance of comrades, and to avoid the mutual depression of segregation in a "blind ward."

3. *The work in the United States.*—

(a) At port of debarkation: Continue recreation and occupation under a designated expert.

(b) Stations for reeducation:

(1) One or more military stations not far from the eastern seaboard, each to accommodate not to exceed 200 soldiers, with due regard for their proper classification.

(2) A director at each station to be directly responsible for all vocational activities, including the selection of personnel and the determination of the nature and extent of the training to be provided in each case.

(3) Provide suitable instruction in such subjects as the approved uniform embossed system in reading and writing, writing with pencil and typewriter, transcribing from the dictaphone, telephone switchboard operating; in such manual occupations as weaving, woodworking, cement work, netting; in recreations; in physical training through gymnastics, athletics, swimming, bowling, boating, etc.

(4) The director to recommend and secure any additional educational training deemed advisable and accepted by the patient, including college, professional, or intensive training in existing shops or factories.

(c) Placement and follow-up work:

(1) A Federal placement agent to be appointed to ascertain opportunities for the blind, in cooperation with such Government agent as is empowered to make similar surveys for handicapped men; he to assist in procuring such employment.

(2) Prepare the blind soldier to return to his former occupation or one closely allied.

(3) In the case of the helpless blind, to so instruct some member of the family as to enable the blind man to be usefully employed.

(4) Amend civil-service regulations so as to open opportunities for the blind.

(5) Follow-up work under the Medical Department to be continued during the period of compensation payments, in cooperation with the War Risk Insurance Bureau and the American Red Cross.

(6) The use of properly organized and directed volunteer service in providing entertainment and in supplementing the work of the placement agent.

The plans also gave tentative lists of the types of recreations and training to be used, and suggested that the work be initiated at once by commissioning

two designated men of experience to assume charge of the work, one in this country and one in France. The immediate necessity for a definite policy for the employment of teachers was noted, and the advisability discussed of drawing one or two from each of the leading institutions for the training of the blind. It was also suggested that one or two high-grade instructors in mechanics be employed to study the problems of the blind with the blind, in order to invent simple contrivances which would allow them more successfully to compete in industrial occupations with able-bodied workmen.

Men rendered totally blind presented one of the most difficult of reconstruction problems, in part because of the great initial depression coexisting and often continuing over long periods, and also because of the difficulties surrounding any attempt at reeducation, more especially of direct vocational training.² It was particularly necessary that these unfortunate men be protected against excessive sympathy on the part of the public, such as would tend further to depress the blind and convince them of the hopelessness of their situation. It was essential that each blind soldier be convinced that he might be happy and useful though blind, and it was felt that the best way to attain this desired end would be to bring him into contact as much as possible with blind persons who had in the largest possible measure overcome their handicap. Indeed, this was true of severe mutilations as well, and it was hoped that, as time went on, a large number of instructors and "cheer-up" workers might be drawn from this class.²

It was decided to concentrate the work for the blind at one hospital. A private estate of 100 acres in the outskirts of Baltimore, Md., known as "Evergreen," was loaned to the Government for use as a hospital for the blind. This was taken over on November 15, 1917,³ and organized as General Hospital No. 7 on the 27th of that month.⁴ The construction of the necessary buildings to supplement those existing was not begun until April, 1918, owing to the congestion of transportation facilities.³ Some alterations were also necessary to adapt the existing buildings to hospital purposes. No equipment for physiotherapy was considered necessary. The first patients were received in April, 1918, and there were 105 enrollments during that year.⁵

RECONSTRUCTION SERVICE, GENERAL HOSPITAL NO. 7

The initial work of the educational department was begun on July 5, 1918, when the educational director arrived at General Hospital No. 7 to take up the work of reeducation of the blinded soldiers.⁶ Owing to the fact that the educational buildings were not completed, it was necessary to have sessions in the hospital building known as Evergreen Junior. During the months of July and August there were two reconstruction aides engaged in the work of teaching Braille, typewriting, English, and arithmetic. A physical instructor was employed, and two normal-sighted enlisted men assisted in the educational work. A teacher from the Maryland School for the Blind came several days a week to teach handicrafts.⁶

Blindness, perhaps more than any other handicap, limited the physical activity of the individual. He was thrown into an entirely new world and needed, as it were, kindergarten training as a preparation for entrance into the

new sphere of existence. The hand and the ear must take the place of the eyes. The hand especially must be used much more than before blindness, and consequently needs to be trained to distinguish objects and handle them effectively. The education of the blind implied greater individual attention to the pupil than did the education of the normal-sighted. In educational institutions for the young blind the number of teachers must therefore be greater than in institutions for the normal-sighted. But in educational institutions for the young blind one finds for the most part individuals who have become accustomed to their blindness or who have been blinded from birth. In an institution where practically all of the students are newly blinded the need for individual instruction is most evident. In the teaching of typewriting and Braille, for instance, because of the physical and mental condition of the patients at General Hospital No. 7, the instruction was necessarily individual.⁶ On October 14, 1918, a schedule having been planned for regular instruction in the fundamental subjects, work was begun in the new group of educational buildings.⁶ A supervisor of Braille and a supervisor of handicrafts were appointed and organized their respective divisions.⁶ The greater part of the teaching was done by volunteers who had been trained by experienced workers for the blind. The supervisors themselves were experienced in work for the blind.

The initial work of organizing the educational department having been accomplished, it was evident that the patients would need to be encouraged to undertake the fundamental training.⁶ Unfortunately, the patients previously had been told of the wonderful opportunities lying before them of earning large sums of money and of being able to do many things which the blind certainly could not do. These statements had been made to them by individuals who knew relatively little about the blind.⁶ Consequently, when the suggestion of studying Braille, typewriting, and manual training was made to some of the men they were discouraged at having to start, as it were, at the very beginning of the training, on processes which seemed to be slow in producing results. This produced an antagonistic attitude of the patients toward the civilian instructors, which, however, was soon changed when they learned that their instructors were interested in their welfare.⁶ The attendance at school improved steadily. At this time there were not more than 12 men in the hospital.

During the month of October a recreational leader was employed who through her ability and untiring efforts, helped to raise the morale of the patients.⁶ She organized a dancing class under a skilled teacher of the blind. Dances were held regularly. She read aloud to the men, arranged theater parties and automobile rides, and by the beginning of January, 1919, had a well-organized recreational department. Her aim was a high one and one which showed that she understood the blind and that their need was the ability to express themselves—to trust themselves and their impressions.

On November 30, 1918, there were 30 men enrolled in the educational department.⁶ The attitude of the men by this time had improved greatly. Men who had at first refused to attend school were attending regularly. Men who had been accustomed to coming late to class were coming before class time and staying after class.

OUTLINE OF THE WORK

MANUAL TRAINING

The patient's first work was caning a chair.⁶ The object of this was to cultivate the touch of the fingers and to teach direction. Caning also had some commercial value, though it was not taught with this end in view. The next operation was netting; each man made a hammock. This brought into play the larger muscles of the hands and was a different operation. Then followed basketry, which was a more advanced form of finger training and allowed of creative work. There was also some simple weaving. Following this came a course in woodworking. The use of tools was taught, and men made such objects as match-box holders, coat hangers, clothes lockers, and stools.

READING AND WRITING BRAILLE

With the loss of sight came the need of learning to read and write with the fingers. This was naturally a slow and nerve-racking process, and the individual was inclined to become discouraged. For that reason the personality of the teacher was of great importance and the need for individual work could be understood. However, men who had objected strenuously to learning Braille had seen the need of such instruction, and under the encouragement of interested workers were then receiving help.⁶ One of the operations which joined a man in his new life to the sighted world was pencil writing, and when he discovered that by means of a pencil and corrugated paper board he could write to his friends he had made a new step forward and some light had been brought into his world of darkness.⁶

TYPEWRITING

Typewriting proved to be the most popular study with the men.⁶ The interest in typewriting was enhanced by the fact that a Corona typewriter was presented to each patient by a woman who was interested in the war blind.⁶ For this reason all men were taught first to use the Corona typewriter. When they passed the examination given by the supervisor of typewriting they might learn to use some standard machine.

PIANO TUNING

Instruction in piano tuning was begun, but because the length of time needed for training a piano tuner was from two to three years and because there would probably be few of the war blind who would undertake that work the piano tuning was dropped from the course of instruction.⁶

MASSAGE

One man received instruction in massage and subsequently practiced in the clinic of Johns Hopkins Hospital.⁶

BOOKBINDING

An expert instructor in bookbinding was employed to discover the capabilities of the blind for this work.⁶ It was his opinion that the binding of pamphlets in large libraries could be done successfully by the blind.

ACADEMIC WORK

Instruction in English, arithmetic, spelling, mathematics, Latin, and other academic subjects were given from the time of the inauguration of the work in the educational department.⁶

VOCATIONAL INSTRUCTION

A course in salesmanship and personal efficiency was instituted.⁶ There were classes in poultry raising and agricultural work, courses in woodwork, in factory management, and in auto mechanics.

On December 30, 1918, there were 7 paid teachers, including reconstruction aides, and 32 patients enrolled in educational work.⁶ The majority of the instructors were individuals of experience and ability who had volunteered their services, but in a few instances, unfortunately, of those in executive positions, their experience was not largely connected with the teaching of the blind nor with military affairs. The schedule of instruction was not entirely satisfactory, in that it was too optimistic along certain lines as to the ability of the reconstructed blind to compete with those not blinded.⁶ These conditions delayed the establishment of an efficient educational service, and were not corrected until the basic plan for the functioning of the hospital was radically changed and certain changes in personnel made.⁶

DISCONTINUANCE OF THE MILITARY STATUS OF BLINDED SOLDIERS

Investigations of the conditions indicated that these blinded patients would be benefited by a termination of their military service at as early a date as practicable.⁶ The psychological reaction of these men in the early stages of this new life which they must lead was radically different from that of the ordinary wounded men, in that the regaining of their independence from the assistance of others at as early a time as possible was of paramount importance, and the idea of military discipline, escorts when away from the buildings, prescribed courses of instruction, etc., engendered a feeling that they were being forced along lines of reconstruction which they would follow with far greater ability and success if they were permitted to feel that they themselves were the main factors in their rehabilitation.⁷ Therefore, the Surgeon General, early in 1919, recommended to the War Department⁷ that all blind patients then in the hospital be discharged from the service at once, and that thereafter blinded patients should be treated in General Hospital No. 2, Fort McHenry, Md., until the maximum amount of physical recovery had been attained, when they should be discharged; and that both classes should be turned over to the Federal Board for Vocational Education for training when discharged; that General Hospital No. 7 thereafter should function under the American Red Cross, with cooperation from the Federal Board for Vocational Education and the War Risk Insurance Bureau. That this hospital should be retained as a military organization, but that military supervision should extend only to the maintenance of order and discipline and to the protection of property. That the War Department should turn over to the American Red Cross all the buildings equipment, etc., then in use or requisitioned.

This policy was approved by direction of the Secretary of War on April 9, 1919.⁷ Sixty-four patients were discharged from the service on May 22, 1919,⁸ and on May 25, the responsibility for the functioning of the hospital was assumed by the American Red Cross.^a

General Hospital No. 7 had a normal capacity of 100 patients. The number of patients in hospital remained below 50 until December, 1918. After that month it remained between 100 and 150 until the hospital was taken over by the American Red Cross.⁹

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^a Consult Chapter X, *infra*, for an account of the activities of the American Red Cross in the aftercare of the blinded.

CHAPTER VII

IN HOSPITALS CARING FOR DEFECTS OF HEARING AND SPEECH

Reconstruction plans for patients suffering from defects of hearing and speech were assigned at first to the section of the division of special hospitals and physical reconstruction which provided for the blind. This section was divided in March, 1918, its two component parts thereafter functioning separately.¹

Some work had been done in connection with plans for the reconstruction of patients suffering from defects of hearing and speech during the fall of 1917 and the following winter.² This work had been one of the duties of a medical officer assigned to the section of head surgery and he had called upon a civilian committee to assist him. The outline of a tentative plan of action formulated in consequence in September, 1917, is as follows:² (1) Consideration of the methods of physical treatment of defects of hearing and speech at the front. (2) The reeducation of the deaf and the correction of speech defects, at the front, immediately after the injury or disease; transportation to the interior district where the reeducation would be begun, or transportation to the United States where the reeducation could be carried on under better circumstances and to better advantage. (3) To employ only one method—that of speech reading—in the reeducation of the near deaf or the completely deaf, except in the few cases in which the manual method might be necessary. (4) Necessity for a school to train teachers, the available supply being too limited to meet the expected demands. (5) Provisions for any plastic operations preceding the teaching of speech correction could be instituted. (6) Consideration of the question of rehabilitation, especially with reference to those suffering from defects of hearing.

This plan was approved by the Surgeon General as a basis for future work.³ Subsequently, however, additional details included:³ (1) A canvass to be made of teachers of lip reading and of corrective speech in the United States, with a view to employment. (2) The physical treatment to be done abroad, the correction of deafness, so far as practicable, through local treatment, rest, and removal from the din of battle. Through this means the temporarily deaf and the moderate defects in speech were to be separated from the permanently deaf and the apparently incurable defects in speech. (3) It was not feasible to start reeducation abroad because of the difficulty in selection and segregation; unfavorable environment for the teaching; difficulty in maintaining proper supervision of reeducational work of this type. (4) Though the work could be done in a reconstruction hospital, it was desirable that an institution devoted exclusively to this purpose be used. There were to be one supervisor and six teachers for each section of 50 beds. (5) The personnel of each teaching center was to comprise one head teacher in lip reading; one teacher in corrective speech, who was to give one lecture per week for four months; one volunteer otolaryngologist to lecture on anatomy and physiology of the ear, nose, and throat. (6) Cadet teachers were to be selected for the training classes through

the cooperation of the women's committee of the National Defense Council or a similar committee of the American Red Cross; to be at least 25 years of age. Each cadet teacher was to have the equivalent of a normal-school education; to receive no compensation while in training, and \$60 per month, with lodging and board, after employment. (7) Training schools were to be established in 10 large centers, independent of established schools, each school to give two courses—total expense, \$1,400. Ten additional teachers were to be employed in order to give an intensive individual course. (8) This reeducation service was to be placed under a qualified man, preferably medical, who was to be responsible for the development of the details of the training classes. The courses were to be standardized, and were to include a thorough training in the proper formation of the elements of speech, gymnastics of the tongue, proper breathing and calisthenics necessary in the development of the breath and voice, lectures on musical vibrations, special work in the development of hearing with music, and voice placing. (9) Curative workshops were to be established at each reconstruction institution where these classes of patients were received for such occupations as carpentry, painting, mechanical drawing, printing, iron-work, wood turning, metal work on lathes, bootmaking, bookbinding, broom making, mattress making, rubber working, and gardening. The advice of civilians suffering from similar defects was to be obtained as to occupations which it would be best for these men to follow. Public employment agencies and industrial organizations were to be convinced that the deaf were not abnormal people in that they had substituted another sense for one in which they were handicapped.

No further preparatory action on this subject was undertaken until March, 1918, when a detailed plan was formulated in the reconstruction division. This plan was so complete that it made provisions for contingencies which never arose.³ In brief, it was an elaboration of preceding plans, with two exceptions: Though foreign statistics, known to be incomplete, indicated that 2 per cent of all casualties would constitute those of hearing and speech, it was concluded that the proportion in our Army might be as low as one-half per cent, as our men were subject to a more rigid examination at the time of induction into the service; the proposal to establish training courses had been found to be unnecessary,² and in lieu of them commissioned personnel for this work at three general hospitals—No. 11, Cape May, N. J.; No. 2, Fort McHenry, Md.; and No. 9, Lakewood, N. Y., was provided for. This latest plan was approved by the chief of the division, but the work was eventually established in only one general hospital—General Hospital No. 11.¹

INAUGURATION OF THE RECONSTRUCTION SERVICE

Much difficulty was encountered in finding a suitable location for establishing a special hospital for the purpose. With one exception, the rental demanded was inordinately high, and the exception was a building of frame construction, with too great a fire risk.¹ It was therefore decided to establish the work as a separate service in General Hospital No. 11, Cape May, N. J.¹ The teachers were employed as head reconstruction aides and the service was formally inaugurated July 24, 1918, with 17 patients.¹ With the exception of a few,

these first patients were reluctant to take up the work. This was to be expected; these young men had been assigned to hospital, and they saw in the new line of treatment to be inaugurated nothing further than a prolonged stay in hospital and in the Military Establishment. They feared that nothing further could be done for them, and they were anxious to be discharged and to be permitted to go home. Several patients were extremely reluctant, and two of these had to be disciplined in order to bring them to the proper appreciation of the necessities for the treatment. After the work and the treatment had been in progress long enough, so that some of the earlier students began to read with proficiency, the views of all in the hospital were changed. The recalcitrant patients became anxious to follow in the steps of the proficient ones, and new patients inducted into this line of treatment were anxious to take up this work as they saw the benefit which had been obtained by those who preceded them.¹

NUMBER OF CASES EXPECTED AT GENERAL HOSPITAL NO. 11

Throughout the whole work in connection with this section it had been attempted time and again to obtain statistics as to the probable ratio of the number of the near deaf and deaf to the total number of casualties in the various allied armies, so as to make, if possible, advance preparation for the patients to be received.² Usually these efforts were without results. The best received were the statistics furnished by the British Pension Bureau, viz:² That out of the total number pensioned for disability from the beginning of the war to May 31, 1916, 2.9 per cent were on account of deafness, while from the beginning of the war to May 31, 1918, the percentage was 1.98. A further report stated that from the outbreak of the war to August 31, 1918, the total number pensioned for disability is 421,877; of these, 7,731 are invalided on account of deafness, a percentage of 1.83.

These figures indicated that the United States, under the same conditions, would have the same ratio of deaf in connection with the total disabilities. As stated above, a smaller ratio was expected, for two reasons. First, our men, as registrants, were more carefully examined, and those with defects in the auditory organs were rejected. Some few of those who were accepted and taken into the service, on reexamination were excluded from overseas duty and retained for domestic service. In the second examination of recruits all cases of suppurative otitis media were excluded, as well as those showing any catarrh in the middle ear. Those with any degree of impairment of hearing were accepted only for limited service. Second, a large number of the defects in hearing which occurred in the service of the Allies in the war were attributed to trench warfare. Trench warfare practically closed with the entrance of the American Army into the conflict, and, therefore, a large percentage of ear afflictions which were due to trench warfare were eliminated from our service. These two factors were thoroughly considered in the preparation at General Hospital No. 11, and those concerned were not disappointed.²

PROCEDURE ON ADMISSION

All patients were examined in the otolaryngological section of the hospital.² They were all tested out and their conditions noted. The complete deaf, of whatever character, were immediately assigned for speech reading. The near

deaf and those having deafness in both ears under 5/20, in which the condition of the ears indicated that the hearing would become progressively, although gradually, worse, were also assigned to the speech-reading department. Most of the cases found had some degree of impairment of hearing before entering the service.

It is noteworthy that from the period of December 31, 1918, there was not seen what could accurately be designated the so-called shell-shock deafness.² There were two cases which bore very close resemblance to shock concussion—that type of cochlea injury which is attendant upon exposure to hours of intensive gunfire in which high-explosive shells predominate.

METHODS EMPLOYED IN TEACHING

The course which was adopted in speech reading was of the individual instructive type.² Each patient was given one-half hour instruction twice daily at the beginning. Two study periods a day proved sufficient for most men. They were given mirrors with which to study their own lip movements, and they were very assiduous in their efforts toward improvement, anxious to gain all the advantages that could accrue from intensive work. All white patients were fairly bright men who had recently become intensely deaf; not possessing any other type of injury, they were more than anxious to remove this one handicap so as to be restored to normal. Contrary to the expectation of some of the teachers of the deaf, no case required manual teaching. Even cases of the most unpromising character, seemingly of the lowest type of mentality, acquired the speech-reading art with unusual facility.

Appreciating the fact that, in all probability, a certain number of cases would enter the hospital who could be improved and whose hearing could be restored through resorting to the auricular method of training, this subject was given a most thorough consideration.² After examining the various methods which had been adopted by the Allies in connection with this work, it was decided that the auricular method, in which the human voice was employed, seemed the most logical and most promising of results.² This was the method which was reported to be used most extensively in the various French hospitals and institutions to which the deaf were assigned. A full system of carrying out the auricular method to be used by the staff at General Hospital No. 11 was prepared. It was intended to adopt individual methods of training and, if necessary, multiplication of this through phonographic attachment. The staff at this hospital, fortunately, found this employment indicated only in one or two cases.

In the French service it was expected that the average soldier would require about three months for a course in speech reading.² In the British Army it was expected that the same results would be obtained in four months.² It had not been expected, nor was it intended to make any effort to excel either the French or the British in this type of work.² The effort was simply to give the American soldier the best treatment possible. The method was an intensive one, giving the patient a couple of periods a day, or three, if such could be maintained without causing mental fatigue. It was expected, also, to find that some patients would not be able to grasp the method and to continue the course.

This proved to be untrue; all of the patients showed energy in the work and keenness in desire, which gave a result far beyond expectations.² Not only were the patients able to read, but also before they were discharged they were able to read well the speech of all people with whom they came in contact.

SPECIAL INSTRUCTION FOR ILLITERATES

Illiteracy proved a serious impediment to speech-reading work, particularly among the naturalized foreign born and most of the native negroes. Since there was not enough work for the aides in speech correction, it was decided to give the illiterates an opportunity to remove their handicap. It was astonishing with what rapidity the aides, not only in the defects of hearing, but also in corrected speech work, removed this impediment. Men who could neither read, write, nor figure would acquire the elements of speech reading within a week or 10 days, and then the instructors would begin with the primary education.

CLASSIFICATION OF PATIENTS

DEFECTS OF HEARING

Defects of hearing were of two main classes, etiologically:⁴ (1) Those due to ordinary diseases common in civil life—acute and chronic mastoiditis, acute and chronic catarrh of the middle ear. (2) Those due to warfare: (a) Shock concussion, most frequently due to the action of a single high-explosive shell in the immediate vicinity of the affected; many of these cases recovered completely. (b) Concussion deafness, due to continuous action of high-explosive shells, shrapnel, or machine-gun fire; these cases probably presented organic changes in the internal ear and were most frequently permanent. (c) The slowly progressive type of concussion deafness so common among artillerymen. (d) Traumatic, due to injury about the auditory apparatus or head.

DEFECTS OF SPEECH

Defects of speech were either congenital, neurotic, or traumatic.⁴ Mutism most frequently of shock origin. Stammering and stuttering, either old cases reestablished or new cases produced during the nervous stress of combat. Aphonias, either neurotic or due to overstrain of the vocal organs, or to nerve and muscle casualties. Affection of voice, due to wounds of the face and upper air tract. The prognosis was fairly good in the majority of cases.

The following classification of cases from a somewhat larger series gives the types of defects encountered at General Hospital No. 11:⁵

BY TYPE	
DEFECTS OF SPEECH	Patients
Aphasic.....	14
Imperfect phonation.....	13
Stammering.....	3
Aphasic and stuttering.....	1
Multiple neuritis.....	1
Aphonia.....	2
Stuttering.....	2
Stammering and stuttering.....	1
Total.....	37

DEFECTS OF HEARING		Patients
1. Cases which have completed treatment.....		63
In line of duty.....	43	
Not in line of duty.....	20	
Otitis interna, result of gunfire.....		2
Shell explosions.....		8
Basal fracture.....		2
Meningitis.....		4
Other causes.....		9
Extension from middle ear.....		14
Deafness from catarrhal ears.....		9
Deafness from suppurative ears.....		22
Of the 22 suppurative ears there were discharged:		
		Patients
Dry.....		19
Cases with hearing much improved.....		14
Otosclerosis.....		1

The labyrinth tests were not routinely done in all cases. Of 6 tests noted, there were sluggish reactions in 3, no reactions or dead labyrinths in 3.

	Patients
2. Cases still under treatment.....	39
In line of duty.....	36
Not in line of duty.....	3
Having otitis interna—	
Result of gunfire.....	4
Shell explosion.....	6
Basal fracture.....	2
Meningitis.....	14
Causes other than middle ear.....	0
Extension from middle ear.....	6
Deafness caused by—	
Catarrhal deafness.....	2
Suppurative otitis.....	4
Now dry.....	3
Hearing much improved.....	2
With otosclerosis.....	1
Hyperactive labyrinths.....	2
Sluggish labyrinths.....	6
Dead labyrinths.....	12

These labyrinths tests were done in the otitis interna cases. The "dead" labyrinths were in the otitis interna cases following meningitis.

So-called "shell-shock" cases.—There were two cases of otitis interna from shell explosion. The otitis interna had cleared or nearly cleared when they arrived here. The deafness continued from hysteria. Under suggestion and with rest, the hysterical condition cleared and the hearing became normal in each case. In one case only one ear returned to normal because the other ear had been deaf for years, a chronic condition. These two were cases which earlier would have been considered "shell-shock" cases.

Two cases died from meningitis, consequent on a chronic brain abscess, secondary to a chronic otitis media, suppurative.

CLASSIFICATION OF PATIENTS FOR DISCHARGE FROM HOSPITAL

On September 20, 1918, the following definitions were made as regards the disposition of patients reaching the stage when they would be ready for classification for either discharge or retention in limited service:²

All patients who are nearly deaf—that is, below the normal register for acceptance into the service previously as recruits—and who have become proficient in lip reading should be placed in class “C,” limited service, for employment in motionless activities only.

Men whose hearing is reduced below 25 per cent of normal, with deafness acquired in line of duty, who have become proficient in lip reading but still hear very loud sounds, should be put in class “D,” without limitation as to motion or motionless activities.

Patients who have more or less marked impairment of hearing, near or complete deafness, who still have a disease of the ear in the form of suppuration, or dry ears which will suppurate from time to time, however proficient in lip reading they may have become, should be discharged from the service.

Patients who, from want of concentration or from intellectual inability, can not acquire proficiency or near proficiency in lip reading and who have to depend upon other methods of communication after due effort has been made on our part, should be placed in class “D.”

TEACHING PERSONNEL

In the speech-reading section, prior to January 1, 1919, there were enrolled as candidates for aides 100 teachers who had signified their desire to become candidates for head aides in the section of defects of hearing and speech, division of physical reconstruction.² In the speech-corrective work there were 51 candidates for corrective-speech aides, under the same qualification, for full military service.² There were a number enrolled as candidates for the position of teachers of speech reading who were not able to give full-time service.²

RESULTS

The work reached its maximum during the first week of November, 1918; after that date there was a gradual decline in the number of patients received, while the discharges were greater than the increase in patients during November and December.⁵ There were therefore at the end of the year 1918 nearly the same number of patients as when the work was started in July.

Fifty-eight patients were enrolled as having defects of hearing; of these, 34 were discharged as well-qualified speech readers, and 3 discontinued treatment—2 because the deafness existed prior to entry into the service, and 1 who was so improved by the auricular method that further treatment was unnecessary.² These individuals had no difficulty other than what was common to most proficient speech readers. Ordinarily it was not necessary for them to request a repetition of what was stated. Eleven patients were enrolled in the training for defects of speech—4 were discharged cured, 2 transferred to other hospitals, and 5 remained.

In order to insure that none of these patients might lapse or deteriorate in their ability to read, but rather be improved, it was decided that all the patients discharged from United States Army General Hospital No. 11 should have the privilege of carrying on practice work at schools or with individual teachers in their home town or near their home town; therefore arrangements were made with a number of schools and teachers throughout the country to give the benefit of their work and effort to our discharged patients, and a similar arrangement was made with the Federal Board for Vocational Education.² They were to furnish practice and instruction to the patients after they had

been discharged from the Army. As each patient was discharged from the hospital he was given a duplicate copy of the name of the teacher or school to which he must apply, also a note or card of introduction to the school or the teacher. The names and home addresses of the patients were also given to the Federal Board for Vocational Education, which prepared to follow up these men and see that they continued the work and maintained the efficiency which they possessed when they were discharged from the hospital.

RECONSTRUCTION SERVICE TRANSFERRED TO GENERAL HOSPITAL NO. 41

The school for the correction of defects of hearing and speech was transferred to General Hospital No. 41, Staten Island, N. Y., on July 7, 1919, upon the closing of General Hospital No. 11.⁶ Twenty cases were then transferred, the majority of whom completed the course on or before September 1, 1919.

A few cases in which physical restoration had not yet been completed were received from time to time, but on November 1 there were remaining only 7 patients with defects of hearing and 14 with defects of speech, and it was expected that these would complete the course before the end of the year.⁷

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CHAPTER VIII

IN HOSPITALS CARING FOR THE TUBERCULOUS

The treatment of cases of tuberculosis is radically different from that of other types of disease or injury, in that all exertion not absolutely necessary must be avoided during the febrile stage and for a period thereafter; furthermore, exertion, when finally allowed, must be increased very gradually and be under constant medical supervision. This fact made necessary a decided difference between the reconstruction work in hospitals for the tuberculous and that in other hospitals, and was a factor in the determination to segregate all such cases in hospitals designated for their care alone. Therefore, the shopwork in tuberculosis hospitals was not used, except as a test of the patient's ability to withstand exertion and as a hardening process before discharge.

In fact, reconstruction for tuberculous cases was a new field and many medical officers doubted its availability, the chiefs of medical service in several hospitals going so far as actively to oppose its adoption after it had been ordered by the Surgeon General. One chief of service thought that tuberculous cases should not be permitted to take exercise in any form,¹ another considered that mental work was deleterious,² while a third could see no good features in any variety of reconstruction activity.³ Although the introduction of reconstruction work into every tuberculosis hospital was mandatory, it was necessary in one, in initiating occupational therapy, for the aides to persuade one ward surgeon to let them see what they could do with a few of his patients.⁴ However, reconstruction was developed, carefully and gradually, in the tuberculosis hospitals, converting to its acceptance officers whose minds were open to reason and removing to other fields the purely obstinate ones who happened to be in positions of authority.

Nine of these special hospitals eventually were established,⁵ the choice of sites being governed both by regional necessity and by favorable climatic conditions.

Though reconstruction was instituted in several of these hospitals as early as the summer of 1918,⁶ the work was not well under way as a whole until about the first of the ensuing year, for most of them were war-time establishments not yet equipped to give this service, and those already functioning were so overcrowded as to leave no room available for the offices, classrooms, shops, etc., of the educational service.⁷

MORALE WORK

The success of the reconstruction work of a hospital, particularly of a tuberculosis hospital, was so dependent on the morale that often the offices of morale officer and chief of the psychological service were combined. The following example indicates the measures used to maintain morale:⁸ At General Hospital, Fort Bayard, N. Mex., the program first emphasized the importance of improving physical conditions, mess, physical environment, etc., wherever

possible. Sick men were likely to be dissatisfied with the mess, however good, and the morale and mess officers went into the wards to talk with the men, partly for the purpose of letting the men know that these officers had a personal interest in them. This was productive of good results. It was planned to control the thought, attitude, and conversation of patients so far as possible by means of personal talks and pamphlets and by building up in them some cheerful philosophy of life. A campaign against talking about troubles and death and for wholesome conversation was planned. The writing and publication of pamphlets to be distributed to the patients was supervised by the commanding officer. School and shop work were advertised by posters and pamphlets and by personal talks of teachers and special workers. Special assistants were appointed to help obtain information as to the morale, conversation, attitude, etc., of the men. Special personal talks were arranged for, to be made by the morale officer, one of the chaplains, or anyone else who might be specially fitted to deal with the case. With the help of the librarian, teachers, posters, etc., attempts were made to extend the use of the American Library Association books for the purpose of building up morale. The teachers and aides helped to stimulate the men to appreciate the school and shop work, to look ahead and make plans for the future, and to avail themselves of all the helps that were at their disposal. Letters were written to relatives and friends asking them to write the helpful kind of letters to the patients. Letters received which concerned patients, their discharge, etc., were turned over to the morale officer by the commanding officer, with instructions that he communicate directly with the writers. It was arranged to have clubs for officers and enlisted men, with an officer to take charge of this phase of the work. A practical, cheerful philosophy of life was outlined to help stabilize and comfort the minds of patients who had no philosophy of life or who were floundering, not knowing what to think, or who were at odds with the world. In a series of lectures for teachers the morale officer made suggestions for the development of morale. Entertainments, recreation, etc., were furnished by the American Red Cross.

Hospital newspapers were active morale agents, considerable thought being devoted to suggestive titles, as "Ward Healer," "The Come Back," and "Carry On," and to contents which would be encouraging, stimulating, and attractive. On the other hand, nothing lowered morale more quickly than poor food. Several of the tuberculosis hospitals suffered from difficulties in the messes at some time, due to various causes, such as inefficiency, the high cost of suitable food, at General Hospital No. 19,⁹ and isolation at Fort Bayard, N. Mex.¹⁰ Inadequate provision of quarters for aides was said to be an important factor tending to lower morale at Fort Bayard, N. Mex.¹¹

PSYCHOLOGICAL SURVEYS

At Fort Bayard, N. Mex., psychological studies were made of series of patients in order to present information to them concerning opportunities which they would encounter in shop and school, and to obtain information for the morale officer concerning the impressions and influences playing on the patient's minds.¹² The obvious benefits to be derived from such studies were the compilations which would indicate the general trend of mental influences

and attitudes in the wards. These generalizations gave composite pictures of conditions, weaknesses, and opportunities which aided in making plans for the groups concerned. The psychology also of the tuberculous patients was revealed more definitely, for example, by the positive optimism of 91 per cent of the patients, while 8 of the remaining 9 per cent were doubtful rather than definitely pessimistic. The chief values of such surveys consisted not in the generalizations afforded but in concrete situations dealt with on behalf of individual patients. The interview in itself had an immediate benefit in giving the patient information of interest to him, and his cheerfulness was increased by giving him a confessor, as it were, to whom he could unload his thoughts. In addition to this, each patient's record sheet was examined carefully, and the various items indicating their individual needs and the various channels through which they could be approached were turned over to the proper reconstruction agent, whether teacher, librarian, shopman, aide, ward worker, morale officer, psychologist, chaplain, or vocational director. Thus the way was opened for a full contact with each patient's need with a minimum of wasted time.

General studies of 407 cases and psychological studies of 132 cases were made with the following general results: ¹²

Race, percentage.—White, 92.1; Negro, 7.4; Indian 0.49.

Occupational, percentage.—Farmer, 31.9; mechanic, 17.6; clerk, 11; laborer, 9.9; engineer, 3.4; salesman, 3.2; carpenter, 2.7; merchant, 2.7; miner, 1.2; soldier, 0.98; and various others below 2 per cent.

Schooling, percentage.—None, 5.1; 1 to 4 years, 12.2; 5 to 8 years, 53.8; incomplete high school, 13.5; high school, 9.5; college, 6.1.

Arm of service, percentage.—Infantry, 35.6; Depot Brigade, 16.9; Artillery, 12.5; Aviation, 10.3; Medical Department, 9.8; Quartermaster's Department, 4.9; Engineers, 3.9, Cavalry, 3.7; Motor Transport, 1.4; Ordnance, 0.73.

Nativity, percentage.—United States, 93.2; Germany, 1.7; Italy, 1.7; Scandinavia, 1.4; and others below 1 per cent.

Mental attitude of 32 colored patients, mostly bed patients in an advanced stage.—Average length of stay in hospital was three and one-half months; average schooling, five years; reading, correspondence, and occupational therapy provided most of their interest; they were less inclined to worry than were white patients, and were more fatalistic; their interest in religion was more apparent than among the white patients. On the whole, the mental attitudes of the negroes ran parallel to that of the whites, their ideas and emotions being perhaps more simple and open to view.

Mental attitude of 100 white tubercular patients.—Average length of stay in hospital, four and three-fourths months. The summaries of the various tables give the best idea of the results.

Chief impressions from present environment.—The reconstruction work occupied fifth place among the leading topics of conversation. The need was shown for increased stimulation in the direction of such healthy activities as were offered by the curative-work shop schedule in order to replace the prevailing discussions about discharges from the Army tuberculosis, restrictions, etc.

Impressions concerning their own cases.—These were chiefly encouraging. Added to the natural optimism of tuberculous patients (10 per cent still believed that they had no tuberculosis) was the distinct encouragement which one-half of them had received from their physicians and one-third from relatives at home.

Immediate interests.—The chief one was reading, which might profitably have been broadened by outlining reading courses for bed patients. Objective and healthy interests greatly outweighed the introspective and morbid. These could have been more profitably directed by expanding the scope of work in occupational therapy, which would have been possible when additional aides arrived.

Future interests.—The patients looked forward principally to resuming their former occupations at home or else simply to being discharged. Prospective school work held a gratifying interest, but they seemed to regard the shopwork as less attainable. The opportunities for consultation with and training under the Federal Board for Vocational Education had not been appreciated as they should have been, and should have been presented more vigorously.

Worries, fears, and causes of discontent.—The main source of complaint was the food served. A number were chafing under the rules and restrictions in force. There was some apprehension, more or less morbid, regarding the high altitude. There was often a need for some one to take up home difficulties, especially the failure of allotments to arrive.

Social instincts expressed.—Ninety per cent showed a friendliness to the interviewers and 58 per cent expressed a wish for more visitors or a feeling of loneliness or homesickness. More systematic visiting was evidently needed; with the arrival of the additional aides which had been requested much of this loneliness and craving for visitors could be dealt with.

Temperament.—Many weeks of confinement did not appear to have shaken the optimistic attitude.

DEVELOPMENT OF THE CURATIVE WORKSHOP SCHEDULE

The curative workshop schedule in tuberculosis hospitals consisted mainly of ward occupations, academic and commercial classroom work, and graduated exercise in the form of walks.

The earlier ideas of reconstruction for tuberculous cases were that the courses would run largely along practical vocational lines, but experience led rather to ward occupations and general schooling;¹³ when patients were physically able to take the shop courses they were very liable to demand discharge.¹⁴ Agriculture in some form was at first looked upon as the ideal pursuit for an arrested case, as it provided an outdoor life with varying degrees of strenuousness. While its theoretical advantages were evident and its practical advantages were demonstrated, the great majority of the patients did not look upon the pursuit with favor, and the enrollment in that course fell far below what had been hoped for.¹⁵ It was difficult to interest officer patients in courses other than ward occupations, owing to their relatively superior education, but many pursued advanced correspondence courses under the guidance of the educational service.¹⁶

Certain hospital activities which ordinarily were included in the curative-workshop schedule were not considered to be proper occupations for tuberculous cases to follow from the standpoint of the best interests of both the patients and others. The physical conditions of this class and the necessary treatments and examinations imposed upon them rather short and irregular working hours. Such activities as the print shop were called upon to deliver work with regularity and within a time limit, and some hospitals felt that the lowering of the efficiency of these various activities necessary for the maintenance of the hospital by the employment of irregular workers was not justified. Furthermore, if the sick and the well were so associated, there would be competition, and the sick men would become discouraged at the greater progress made by the well men. Those not sick would also run a certain risk of infection. These conditions would demand a duplication of plants if the two requirements of efficiency and instruction of the inexperienced were to be attained simultaneously, rather than one set of curative workshops for the conjoint use of the hospital and the reconstruction service. In other activities of the hospital, such as the laundry, bakery, and kitchen, the danger of infection of others

was always a possibility, and the occupations were too confining for tuberculous cases. It was considered to be extremely doubtful if any tuberculous cases should be allowed to engage in painting, plumbing, or printing on account of the possibility of lead poisoning.

EQUIPMENT

Equipment of the shops was quite complete for the class of cases considered and could supply instruction in all lines which their physical condition warranted. In one hospital (General Hospital No. 20) the machine shop was equipped with an engine lathe, drill press, shaper, drill grinder, power hack saw, and a full line of vises, wrenches, workbenches, and small hand tools.¹⁶ The auto shop used the machine-shop equipment, and obtained from the Motor Transport Corps, for demonstration purposes, unserviceable motor vehicles—an Overland motor car, a Studebaker six-cylinder car, a Republic truck, and an Indian motor cycle with side car. The Overland car and the motor cycle were in such condition that they could be used for driving instruction within short distances, although it was frequently necessary to tow them back to the shops. The carpenter shop was equipped with a wood speed lathe, mortising machine, small jointer, circular saw, and workbenches, with a complete assortment of hand carpenter tools. In addition, a small Avery 5-10 tractor was purchased for the use of the shops, and a 10-ton artillery tractor was obtained from the Ordnance Department. Several sets of small field equipment for prospecting for minerals and courses in simple mineral tests were also available.¹⁶

The agricultural section had two 50-egg incubators, a brooder, sanitary rabbit hutches, and a small henhouse.¹⁶

COURSES GIVEN

The courses which made up the curative workshop schedule at General Hospital No. 20 will serve to illustrate such courses in other tuberculosis hospitals:¹⁶

(1) *Academic*.—Algebra, trigonometry, civics, Spanish, penmanship, English for beginners, English for foreigners, journalism, vocational arithmetic.

(2) *Commercial*.—Commercial English, commercial arithmetic, stenography, typewriting, bookkeeping, business law, elements of filing systems.

(3) *Art craft*.—Cartooning and illustrating, basket making, leather work, weaving, toy making.

(4) *Technical*.—Astronomy, meteorology, ore testing, elementary physics, telegraphy, motion-picture operating, photography, mechanical drawing, machine drawing.

(5) *Shop*.—House wiring, sign painting, carpentry, furniture repair, machine shop, automobile repair and construction, auto-ignition systems, tractor operation, tractor construction, tractor repair.

(6) *Recreational*.—Piano playing, mandolin playing, orchestral instruction.

(7) *Agricultural*.—Poultry raising, rabbit breeding, farm management, cold frames as a factor in growing vegetables, alfalfa culture, corn culture, onion culture, barley culture, dairy husbandry, swine husbandry, sheep husbandry, vegetable gardening, beekeeping.

(8) *Correspondence courses* (courses offered through the courtesy of the Agricultural College of the University of California).—Milk-goat raising, pear culture, plum and prune culture, walnut culture, almond culture, grape growing, citrus fruits, olive growing, fig culture, canning and preserving, date culture, certain semitropical fruits, avocado culture, lumber and its uses, the business aspects of California agriculture.

SELECTION OF COURSES FOR INDIVIDUALS

All of the tuberculosis hospitals employed a system of classifying patients in three main divisions, based on their physical conditions, in order to facilitate assignment to reconstruction work.¹⁷ The arrangement varied in the different hospitals, but, in general, bed patients were febrile cases and took very little work; ambulatory patients were permitted mild exertion with prescribed rest periods; the inactive patients gradually were brought to a full day's work. The most complete classification coordinated both the assignment of curative work and the location of the wards with the physical condition, as follows:^{18 19}

Tuberculous patients were divided into four classes, the wards into four corresponding groups, and reconstruction work was assigned to patients according to their classification as given below. Each patient, except those critically ill, was to be given something to do, and his day planned for him in a rather definite régime. Patients were taught that the treatment of their cases was a progressive affair, and that the aim of the entire staff was to help them to progress through the successive classes to that consisting of the healed and inactive lesions, and to "graduate" from the hospital by discharge from this "graduating" class and from the hospital. Exercise was a part of the treatment. A brief of a patient's clinical history was presented to the chief of the medical service before prescribing the exercise, and the kind, amount, and results of the exercise performed were entered in a book kept in each ward. The exercise itself was conducted by the reconstruction division, but the responsibility, so far as concerned the patient, rested with the ward surgeon who prescribed the exercise and observed its effects.

Class D comprised patients with a persistent temperature above 99°, extensive active lesions, hemorrhage, progressive lesions, or any other condition requiring confinement to bed. These patients were assigned to a group of wards having closed connecting corridors leading to the mess hall, surgical pavilion, and laboratory. Knitting, embroidery, crocheting, and raffia weaving were the varieties of reconstruction work assigned to them.

Class C patients were those showing a persistently rapid pulse, excessive cough, loss of weight, dyspnea, or extensive inactive lesions. They were permitted to take a little exercise, and were located in a group of wards near the main mess hall. The same handicrafts as for class D were prescribed, but with longer hours. Classes in commercial and academic courses and light games were also allowed.

Cases showing little or no activity and requiring an open-air life with plenty of rest and regular hours, and without too much or too violent exercise, were classified as B and located in a group of wards one-fourth mile from the mess hall. These were given such courses as carpentry, gardening, wood carving, automobile repairing, plumbing, agriculture, animal husbandry, light games, and graduated drill in the school of the soldier.

Class A patients were those showing no evidence of active pulmonary disease who were being hardened preparatory to return to duty. They were housed in a group of wards three-fourths of a mile from the main buildings, were gradually put on a schedule of full work, including one or two hours drill daily, and

were not required to observe the usual rest hours. They wore brassards to identify them as belonging to the "graduating class."

Patients in the febrile stage of the disease, and therefore taking the "rest cure," were inclined to become very restless and discontented. The ward handicrafts, the simpler academic studies, and reading, were particularly adapted for this class of patients, requiring a minimum amount of exertion and concentration, could be laid aside at any time, and served to quiet the patient's restlessness and reawaken his desire and hope for recovery. Some care in the selection of handicrafts was necessary in order to avoid those which might have provoked a man into a too strenuous effort through complexity or absorbing interest of the problem. Rake knitting, mat weaving, weaving on small looms, beadwork, basketry, clay modeling, block printing, and simple studies fulfilled the requirements at this stage.

For patients confined to the ward but not confined to bed the porches were equipped as workshops where reed and willow basketry, bookbinding, loom weaving, and wood carving were carried on. Patients who were classed as "ambulant" were given graduated walks, with prescribed periods for walking and for resting, and were under close medical observation at all times. These walks were graduated from 1 to 4 miles, and patients who completed this course successfully were then given light work in the workshops, in animal husbandry, or in agriculture.²⁰ At Fort Bayard, N. Mex., a period of physical exercise and manual labor was considered to be necessary as a test for a false arrest of the tuberculous process, for a number of patients had suffered a relapse when subjected to real work after discharge.²¹ The types of work prescribed varied in the different hospitals—graduated walks, agriculture, animal husbandry, auto mechanics, and a system of graduated exercises. However, at General Hospital No. 21 no such test was used during the earlier stages of its operation, for at that time the chief of the medical service believed that no form of exercise was beneficial for tuberculous cases; nevertheless, 96 per cent of the patients discharged were recorded as being without any disability, although there had been no test to ascertain whether or not they were able to perform physical labor without a relapse.²²

The careful selection of recreations was necessary in order to avoid over-exertion or too much excitement, and they were confined principally to such games as checkers, chess, cribbage, quoits, to automobile rides, and entertainments of various kinds. At general hospital, Fort Bayard, N. Mex., special effort was made to get entertainment into the wards where the patients were too sick to get out to the entertainments furnished for ambulant patients.¹¹ One of the functions of the ward workers was to recruit entertainment material from among the patients in the wards where the patients were well enough to help entertain and have them help entertain in the wards of bed patients. The ward workers themselves were not bed patients. It was very difficult to keep the group of ward workers recruited up to full strength—i. e., one for each ward, owing to frequent loss by transfers, etc. An entertainment committee representing the American Red Cross, Young Men's Christian Association, and the Knights of Columbus cooperated to have entertainments in the wards where the bed patients were. This committee used patients for entertainers as much

as possible and reported to the morale officer. The work of this committee was coordinated by him. The recreational officer was required to teach patients to entertain themselves.¹¹

At Fort Bayard, N. Mex., academic and commercial subjects were assigned to patients whose physical condition permitted, but here also the necessity for watchful supervision in the character and duration of the work was evident.¹¹ The necessity for shorter daily periods available for instruction than was customary in other hospitals required a relatively larger teaching force. As in other hospitals, the Americanization courses proved to be among the most popular and most valuable of all the courses offered.

CURATIVE WORKSHOP SCHEDULE, GENERAL HOSPITAL NO. 8, OTISVILLE, N. Y.

The records of General Hospital No. 8, Otisville, N. Y., provide material for the following account of the functioning of the curative workshop schedule:²³

BEDSIDE HANDICRAFTS

Bedside handicrafts became the line of work which occupied the time of the greatest number of patients. Ward surgeons who were skeptical about the work at the start became converted to belief in this type of work and many expressed themselves strongly in favor of it. Indeed, for many weeks the chief educational officer was overwhelmed with a demand for aides at a time when no aides were to be had. Before the first aide came to the post both the chief educational officer and his assistant entertained a lively prejudice against the work of the reconstruction aides. They felt that handicraft work was a form of activity which kept men from doing something more worth while, and had noted this to be the case in some other hospitals. This difficulty did not appear at General Hospital No. 8, however, due in part to the fact that the head aide realized the importance of urging men to do the most virile work possible. A factor of even greater importance was the classification of wards, by which patients who are able to do physical work were assigned to wards where they were required to take exercise under the supervision of the reconstruction department, where the aides did not go.

BEDSIDE ACADEMIC INSTRUCTION

Though some men in the wards considered that handicraft work was beneath them, to many of them bedside academic instruction came as a welcome diversion. Some few subjects, such as modern languages, could hardly be taught successfully, and the attempt to give instruction in them could be justified only as a therapeutic measure. In many other subjects, however, notably in arithmetic, English, free-hand and mechanical drawing, patients could work successfully in bed. The method used was a modification of the correspondence-school method. Patients worked by themselves as little or as much as they would. Instructors visited them daily for 10 or 15 minutes, went over their work with them, and gave them encouragement. The best proof of the success of this work was that the enrollment increased steadily from its beginning. As one ward surgeon expressed it, the patients were quiet, busy, satisfied,

and rested better during the rest period. Those who were ambitious looked forward to the time when they would make use of the knowledge they had gained.

CLASS WORK

The success of voluntary class work had been subject to serious limitations. Most patients had been eager to leave the hospital as soon as possible and had felt that if they were in condition to do serious work they ought to be allowed to go home. Hence, they often protested against reconstruction work on the ground that their thoughts were elsewhere or that they would not be there long enough to make it worth while to take up the work. When they had been persuaded to take up work on therapeutic grounds their objections soon were driven from their minds. It was quite possible for one to get in a substantial addition to his attainments in bookkeeping, poultry and beekeeping, penmanship, typewriting, and English. In these subjects satisfactory results were obtained, either by means of individual instruction or by the use of unit courses covering a small part of a subject in a few days' time.

English for foreigners has been especially successful, partly because of the eagerness of the students and partly because of the time allowed daily—twice as much as in the case of any other subjects in which class instruction was given. Even in salesmanship, stenography, Spanish, telegraphy, and wireless men laid a good foundation for future study. Here, as elsewhere, an enthusiastic instructor could do much for students, even in subjects where, apparently, a long period of study was necessary to get any results. Class work seemed to be especially successful in cases involving large numbers of men of moderate attainments who desired instruction in elementary subjects.

THERAPEUTIC WALKS

The graded therapeutic walks prescribed by the Medical Service was an important part of the reconstruction work. Due to the close supervision of these walks and the careful grading of the patients, there was a steady and progressive physical upbuild. All patients before undertaking any of the outside-the-ward occupations must have passed through the four lengths of walks. Ward surgeons praised these walks as a means of testing the patient's endurance; patients looked upon them as a means of developing their strength after a long time in bed.

SHOP AND FARM WORK

After they had finished the course of graded walks patients were required to take up therapeutic work either in the auto or carpenter shops or on the farm. They made their choice of the one to which they should be assigned. Shop and farm work proved quite practical for tuberculous men whose physical condition had been carefully tested before they were allowed to take either up. During a period of many months' observation no patient was obliged to quit any of the outside work because of increased tuberculous activity.

CARPENTER SHOP

Though the activities of the woodworking shop were under the head of carpentry, the actual projects completed and work done embraced carpentry, cabinetmaking, pattern making, and general millwork. Nothing but real jobs were handled. The men in the drafting room were instructed first along the lines of theory, that they might be equipped to turn out complete working drawings and blue prints necessary for the work in the shop. This type of course promoted great interest, proving the real value of the relation of shop mathematics, strength of materials, and bills of stock in connection with the finished product.

As the men were received for the woodworking shop they were graded in accordance with their physical condition, working through from the lighter bench work to the more active operation with the circular saw and power mortiser. Along with the therapeutic value of the work the men gained an opportunity to enlarge their experience along the lines they had chosen, which added great interest to their activities, in many cases developing initiative with an actual business end in view. This specializing project was not lost sight of. One patient drafted plans for a home which he hoped to build soon; another patented a machine for cleaning chicle and made large patterns from which his castings were to be prepared. In these and similar cases the shopwork proved of great value from the standpoint of both instruction and morale.

There were three points in favor of shopwork—the physical value to the patient, the vocational instruction received, and the value of ways and means in production both to the patient and the hospital. The physical condition of the patient improved by graded exercise, which many times had been taken unknowingly. Due to the fact of the interest developed by vocationalizing the work, combined with factory production, one of the first examples of the methods used to obtain this end was through the production of four styles of footstools in which many bench and machine operations were contained; 250 of these stools were built, to be caned and seated in various ways by the bed patients, greatly expediting that side of the work by furnishing an attractive and practical project at low cost. Of the men assigned to this grade of work it was invariably true that they desired long assignments and more work in the attempt to reach a definite end.

AUTOMOBILE SHOP

Especial interest was shown in the automobile shop, where many men learned some of the fundamentals of auto mechanics and repairs. Many patients were prone to elect auto mechanics because of its pleasurable aspect and its dynamic character, but experience proved that because of lack of consistency and continuous work the therapeutic value of the assignment was not of the highest grade. The danger of the periodic overexertion so often called for in an emergency was also a point of apprehension. With this in view, only men who were especially qualified physically and who had mechanical tendencies were permitted to take up the work.

FARM WORK

The men who elected farm instruction continued the therapeutic work which they had begun on the walks. The work undertaken by the agricultural department was divided into two parts—academic and occupational. In the academic group courses were conducted mostly during the winter months—poultry care, beekeeping, farm management, milk bacteriology, animal husbandry, and general agriculture. When possible, these courses were supplemented with laboratory work, such as in poultry care, the practical running of an incubator, and in milk bacteriology the use of the clinical laboratory. The other agricultural courses were strictly academic, standard textbooks being used. Again, in poultry care, trips were made to near-by poultry farms for study and criticism.

In the occupational work a far more diversified program was followed. A 75-acre farm was rented early in the fall and the work of construction of numerous farm projects was begun immediately. First a modern piggery was built, consisting of a 50-foot feed house and a series of small colony houses. Through loan, 14 excellent sows and 1 boar were obtained from the New York City Sanitarium for breeding purposes. Breeding began early in the fall and the results were seen and realized in litters of baby pigs. The small pigs, after weaning, would be kept for use and the sows returned. The work in this swine project assumed not only a therapeutic angle but also became exceedingly vocational. Hospital garbage was converted by thorough cooking into the bulk of feed stock for the pigs.

Together with this project, that of market gardening was perhaps the largest and most extensive. Here the patients were divided into distinct groups for unit courses when feasible. Such units were hotbed construction, the making of flats, sowing seeds, transplanting, the use of farm implements, problems in farm management, etc. With a farm of 75 acres at their disposal, it was planned to produce a large portion of the market stuff for the hospital consumption. The crops were planned with a view of eliminating the more difficult and tedious farm operations, so that light, easy work would always be available for the patients. The heavier operations of the farm, such as plowing and hauling, were performed by a limited number of corpsmen. Plans were under way for a poultry project which would take up the construction of modern poultry houses and an opportunity for poultry management. It was hoped to obtain a collection of some of the best and most practical breeds of poultry, together with flocks of ducks, geese, guinea hens, and, possibly, pheasants. The aim of the department was to accomplish three distinct things in the order of importance; namely, occupational therapy, vocational instruction, and the greatest production of foodstuff possible for the use of the hospital.

The interest of the patients in farm work was encouraging. After being restricted in physical activity for many weeks, the ambition of the convalescent patient was to find some channel as an exit to his youthful energies. He welcomed the out-of-door farm occupation, and more difficulty was experienced in restricting his work than in supplying it. Furthermore, he fully realized that before being sent from the hospital as an arrested case, he must demon-

strate that he was able to do a moderate amount of work without displaying fatigue. Coupling his own innate propensity to once again use his restless muscles with the knowledge that to get a discharge he must prove his measure of resistance, the success of reconstruction through agricultural projects resolved itself simply into organizing the work.

SALE OF FINISHED PRODUCTS

Any immediate financial aspects of reconstruction work in the hospitals for general cases was minimized in the belief that such an appeal was rather stultifying to the high purpose of the reconstruction program and detrimental to the individual. With tuberculous cases, on the contrary, it was found that the production of articles which possessed a commercial value tended to restore a man's confidence in his ability to become a self-supporting producer and had a pronounced morale value, and thereby a therapeutic value, not only in removing a great source of worry but also in increasing his optimism as to the probability of recovery.

PHYSIOTHERAPY

The use of physiotherapy was so limited as to be almost negligible, for two reasons: The patients being nearly all cases of disease rather than injury, its use was less often indicated; tuberculous cases do not react in a beneficial manner to most varieties of this form of treatment.

SEGREGATION OF RACES

The segregation of tuberculous patients, white and colored, in separate hospitals was ordered for the East and South in July, 1919,²⁴ but the hospitals in the other sections of the United States received both classes, segregating them in wards. Though there were exceptions, as a rule there was not sufficient interest in classes manifested by colored students to warrant their continuance.²

REDUCTION IN NUMBER OF TUBERCULOSIS HOSPITALS AFTER THE ARMISTICE WAS SIGNED

The status of the tuberculosis question in the Army having become more or less stationary by the spring of 1919, the Surgeon General was in a position to recommend to the War Department which of the tuberculosis hospitals might profitably be abandoned and which might be retained as permanent institutions. Of the three general hospitals in the West and the three in the East then operating for the care of tuberculosis cases all but two were to be closed as rapidly as their sick could be cured, returned to duty, or otherwise disposed of.²⁵ The excellent railroad connections, geographical location, type and character of buildings, to say nothing of the amount of money previously expended (\$3,250,000) at General Hospital No. 21, Denver, Colo., practically committed the Army to its retention as a permanent institution. As regards a hospital for the East, it appeared to be to the best interests of the Government

and the Army for the latter to operate a tuberculosis hospital in the East, not only to avoid the long transportation of many soldiers from the Eastern States to hospitals in the West but to avoid the depression often found in tuberculous patients separated from their families by great distances over a protracted period of illness. Accordingly, the Surgeon General recommended that General Hospital No. 19, at Oteen, N. C., be retained as the permanent institution in the East.²⁵ The Surgeon General's reason for desiring to abandon the general hospital at Fort Bayard, N. Mex., was based upon the comparative inaccessibility of that place, thus not only making difficult the transfer of patients thereto but also furnishing supplies to the place. Furthermore, fully two-thirds of the buildings there were in a poor state of repair.

Definite approval of these views of the Surgeon General was made by the War Department on April 2, 1919, thus preventing the subsequent abandonment of the other tuberculosis hospitals when need of them no longer existed.²⁵

PATIENTS DISCHARGED AFTER ONE YEAR OF TREATMENT

A new policy regarding hospital cases of long standing was promulgated by the War Department in November, 1919,²⁶ the provisions of which applied particularly to tuberculous cases. Under this policy patients who had been in a military hospital in the United States for a year were to be discharged, with some exceptions, those requiring further treatment to receive such from other governmental sources. This was later so modified as to permit those tuberculous cases who had had treatment for a year, who had active lesions but were making satisfactory progress and would recover within a reasonable length of time, and who so desired, to be retained in Army hospitals for further treatment. This "reasonable length of time" was given a maximum of six months, and no such patient was to be discharged until he had been given a sufficient interval to arrange his affairs—ordinarily about two weeks but with a maximum of six weeks.²⁷ Commanding officers of tuberculosis hospitals were authorized to correspond directly with regional directors of the War Risk Insurance Bureau concerning the cases which were to be transferred to the hospitals of that bureau.²⁸

PERCENTAGE OF ENROLLMENT

The percentage of patients enrolled in the curative workshop schedule varied widely in the different tuberculosis hospitals and at different periods in the same hospital. The figures varied from 20 to 90, with an average of approximately 60. In four hospitals—General Hospitals Nos. 19, 20, 21, and Fort Bayard—the average percentage of patients enrolled in the educational work during five months of the year 1919 was 57.8; 47 per cent of all enrollments were in ward handicrafts, 10.8 per cent in ward academic courses, 21 per cent in technical courses in the workshop, and 9 per cent participated in various recreational activities.²⁸ Table 2 gives certain data on the educational work in the tuberculosis hospitals.

TABLE 2.—*Educational work in special hospitals for the care of the tuberculous, as of the end of the month^a*

Month	Educational staff			Patients		Enrollments		
	Men	Women	Total	Patients in hospital end of month	Individuals enrolled during month	Ward—handicrafts and academic	Classes and shops	Recreational courses
December 1918	135	49	184	4,837	1,465	433	1,123	-----
January 1919	163	73	236	4,900	3,392	812	1,419	-----
February	150	104	254	4,290	1,887	1,152	833	-----
March	139	118	257	4,763	2,654	1,757	798	-----
April	169	159	328	5,136	3,624	3,275	1,664	-----
May	165	197	362	5,321	3,824	4,009	2,193	675
June	173	229	402	5,225	4,792	4,112	2,468	851
July	155	229	384	4,726	4,069	4,767	2,221	1,068
August	114	185	299	4,400	3,338	3,161	1,921	455
September	71	159	230	4,031	2,786	2,695	1,621	405
October	70	183	253	3,601	2,682	2,335	1,298	210

^a Source of information: Educational reports made to the Surgeon General.

GENERAL VALUE

It is difficult properly to evaluate reconstruction work in tuberculous cases, since the psychologic side is so predominant; however, the consensus of opinion of the commanding officers of the tuberculosis hospitals, the ward surgeons, the educational personnel, and the patients was to the effect that curative work in the wards, schools, shops, gardens, and fields was of great psychological and material value in the treatment of pulmonary tuberculosis.²⁹ The commanding officer General Hospital No. 19 stated that he considered the work of physical reconstruction the greatest modern advance in the treatment of tuberculosis, and that he felt strongly that the type of curative work needed was that which was capable of developing interest in the vocation which the patient would later pursue, rather than any considerable quantity of undertakings of the so-called kindergarten varieties.³⁰

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SECTION IV

DEVELOPMENT BATTALIONS; CONVALESCENT CENTERS

DEVELOPMENT BATTALIONS

The thought of instituting special training organizations for the reclamation of incipient physical defects in the large mobilization camps throughout the United States during the World War had its inception in reports received from orthopedic surgeons of several of the camps. The earliest of these, November 23, 1917, was from the orthopedic surgeon, Camp Kearny, Calif., who reported:¹

The treatment of foot conditions presents an enormous problem in the training camp and an attempt has been made here also to systematize, as much as possible, this branch of the work. All cases in the regiment having symptoms that are evidence of insufficient muscular development are listed by company, and the list is submitted to the regimental surgeon. The men are organized into squads in their respective companies, and special foot exercises, at stated times, are given them. The medical and line officers of each regiment are receiving two lectures of one hour each on the subject of feet, the lectures following closely along the lines outlined in instructions received from the Office of the Surgeon General. The company commanders having received these instructions are held personally responsible that these foot exercises are given at the time and in the manner recommended, while it is the duty of the medical officer in each unit to supervise in a general way the whole work. It has been found advisable to number the different movements of these exercises in order that they may be given by the count. In practically all cases showing symptoms the heels of the shoes are being tilted, and shoemakers with equipment and material have been detailed for this purpose by the commanding general. Careful watch is maintained for the presence of symptoms due to wearing short shoes, a condition that is all too prevalent in the Army.

On December 15, 1917, the orthopedic surgeon, Camp Cody, N. Mex., recommended that special squads be organized to drill and strengthen soldiers who were convalescent or who had beginning foot strain before returning them to full duty.¹ Again, on January 31, 1918, the following report to the Surgeon General was made by the orthopedic surgeon, Camp Cody, N. Mex.:¹

Owing partly to the fact that this division is composed largely of National Guard men with previous military service, but chiefly to the active interest and vigorous measures taken by the division surgeon, the orthopedic conditions and prospects are more hopeful in this camp than in any yet seen.

Until a comparatively recent date the number of men discharged upon surgeon's certificate of disability by the orthopedic surgeon was alarmingly large—some 250 in all, of which 191 were classified by the orthopedic surgeon as "flat foot" of various degrees and "broken anterior arch." This resulted in the inauguration by the division surgeon of the orthopedic casual detachment. * * * All foot cases of the less acute and severe types are detailed to this detachment for observation and treatment, the detachment being under the command of a very competent line officer and under the professional supervision of First Lieut. Marion Trueheart, the orthopedic surgeon on duty with the division. The result up to the present time of the activities of the detachment has been the admission of something over 70 cases of varying foot conditions, with the return to duty of about 25 per cent and the discharge upon certificate of disability of less than 2 per cent. From present indications this organization will prove a very valuable experiment for both the division and the orthopedic service. Lieutenant Trueheart has been requested to submit a detailed report of the methods employed as of possible value for adoption in other camps.

On January 31, 1918, a report from Camp Hancock, Ga., was made to the Surgeon General as follows:¹

Am working on the matter of organizing physical training squads in the 112th Infantry. This work presents ever so many minor difficulties. To get the proper officers and noncommissioned officers and to create the proper spirit and get the men isolated are among the most important considerations. Should be glad to see this work in the hands of the physical training department, with the orthopedic surgeon only advising. Just at this time, though, I think it is necessary to get under the proposition and push. The principal points in the organization attempted now are that the bayonet instructor will supervise the physical training, assisted by a competent sergeant. A sergeant is detailed also from the Medical Department to help with this work to treat corns, callosities, etc., and to see that such men as are indicated reach the surgeon. The orthopedic surgeon has an enlisted assistant, formerly a Y. M. C. A. physical director, who assists at the beginning of each new group of exercises by demonstrating each motion during its performance by the class. The exercises are in 12 groups, as per Special Order 23, but the position of "feet parallel" is incorporated, and all exercises are given from this position. The cadence is reduced and every effort is made for accuracy in performance. Men in the squads will not be allowed to relax from military discipline in the slightest degree. There are about 60 men taking the work in this regiment; an additional number will come in soon.

Thus it will be seen that the inception and furtherance of the idea of developing battalions practically was coincident in three widely separated parts of the United States, and as time went on more and more data concerning this phase of physical development appeared in the semimonthly reports of camp orthopedic surgeons made to the Surgeon General. For example, statistics appeared for the first time in the report of the orthopedic surgeon, Camp Cody, N. Mex., February 4, 1918, as follows:

Men reported to the detachment Jan. 14 to 31.....	71
Men graduated and returned to duty.....	18
Men transferred to base hospital.....	4
Remaining, Jan. 31.....	48
Total.....	71

Early in 1918 a memorandum was prepared in the orthopedic division of the Surgeon General's Office, with the view of obtaining authorization of the War Department for the general organization of these special training battalions, but no action was taken on this memorandum at the time.¹ However, on March 8, 1918, the following letter was issued, which, in effect, became the basis of the organization of development battalions later:²

1. Division, depot brigade, and replacement training camp commanders will make necessary provision within their respective commands for the proper physical care and training of their officers and men. Convalescents will be grouped into squads or companies for special physical treatment and, when necessary or advisable, for theoretical instruction in military duties.

2. When officers and men are released from "sick in hospital" or from "sick in quarters," the surgeon should consider whether treatment in a convalescent organization is necessary and recommend accordingly.

3. The line officers and noncommissioned officers placed on duty with convalescent organizations will be carefully selected, especial consideration being given to their qualifications as instructors in the various physical exercises and sports and for their sympathy and interest in this class of work. Medical Corps officers will also be assigned to duties connected with the special physical treatment of convalescents and required to observe individual cases and to make frequent examinations of those under instruction.

4. No officer or man who is physically unable to perform full military duty will be permitted to accompany his organization to France unless it is believed by the medical officers on duty with the organization that he will be able to perform full duty within two weeks from date of departure.

5. Whenever it is believed that officers or privates will be physically unfit to accompany their commands to France, they will be examined by a board of two or more medical officers. In case the board recommends that they be left behind, proper steps will be taken to secure their transfer to depot brigades or other organizations and to obtain other officers or men in place of those transferred.

6. Noncommissioned officers left behind on account of sickness will not be transferred from their organizations. As soon as they are fit to perform full military duty, they will be ordered to join their commands.

The immediate effect in the Surgeon General's Office of the above-quoted instructions was the formulation of the following letter by the chief of the orthopedic division, which, as will be seen, was utilized to a certain extent in the preparation of General Orders No. 45, War Department, May 9, 1918, referred to in greater detail below: ³

In order to standardize the "rehabilitation of the physically unfit" as prescribed in a circular letter from The Adjutant General of the Army to the commanding generals of all Regular Army, National Army, and National Guard divisions, under date of March 8, 1918, it is recommended that the following plan of procedure be adopted:

1. Physical training organizations shall be planned to include all the physically unfit, but more especially the following classes of cases: (a) Men of poor muscular development, general or local; (b) men of faulty posture, general or special, including faulty foot posture without symptoms; (c) men with definite trouble, but capable of being made fit for: (I) general duty; (II) special duty; (d) men recovering from illness or operation, but requiring graduated exercise prior to return to full duty.

2. The men in classes A and B should be assigned to the physical training detachment directly from the detention camp before assignment to line organizations. The men in class C will be partly assigned from detention camp and partly from line organizations where they have broken down under training. The men in class D will be assigned from base hospitals somewhat as to a convalescent camp.

3. *Organization.*—It is proposed that this organization be designated "The Special Training Detachment" as a descriptive title that avoids the suggestion of physical disability. It should be under the immediate command of a selected line officer, who should have the necessary commissioned and noncommissioned assistants. A physical director should be especially assigned for duty with this organization. One of the orthopedic surgeons assigned to camp duty should be further assigned to duty with this detachment and should be in attendance at least twice daily for the purpose of observation and necessary direction. The necessary medical attendance should be obtained by special assignment or by the utilization of the regimental medical officers of neighboring line organizations. It is believed that this organization could be best conducted as a separate battalion of the depot brigade. Under this arrangement men from the detention camp could be directly assigned as to any other military organization and patients from base hospitals and men breaking down in other organizations could be transferred. The battalion could be mustered, paid, and subsisted as any independent organization. The battalion organization would allow the recognition of four different degrees of disability and their segregation into the four companies of the battalion.

4. *Training.*—The training in this organization should be graduated in the four companies to correspond to the degree of disability. The training should be so arranged and graduated that military duties will so far as possible be used in place of or in conjunction with developmental exercises. Camp police, signal drill, manual of arms, and similar light duties can be used to some extent in nearly all cases, and the heavier military duties may be gradually approached by patients with lesser degrees of disability. It is believed that by this method men graduated back to full duty from this detachment will be able to join line organizations without detriment to either the organization or the individual.

5. *Assignment.*—Men should be assigned to this organization upon the recommendation, after a thorough examination, of special physical examining boards officiating in each division. An orthopedic surgeon should be a member of each such board. The physical examining board officiating in the detention camp or depot brigade should be instructed to take special precautions to assure the assignment of all physically unfit and potentially weak men to the special training detachment.

6. There should be established in connection with each such organization a cobbling shop, to be equipped with the regular regimental cobbling outfit and to have assigned to it one or more trained cobblers who can make minor shoe alterations under the supervision and direction of the orthopedic surgeon.

7. After a reasonable and sufficient period of special training, the members of training detachment may be recommended as follows: (a) For general duty; (b) for selected special duty; (c) for discharge.

It was now found that sufficient authority existed for a general organization of a physical developmental movement in the camps, and at a convention of orthopedic surgeons, held in Washington, April 22 to 25, 1918, the suggestion was made by the Surgeon General's representatives, to camp orthopedic surgeons that the subject be gone into by them at once.¹ As a result 12 organizations in as many different camps were formed shortly.¹

After a series of consultations among representatives of the Surgeon General's Office, The Adjutant General's Office, and the General Staff, definite instructions for the formation of development battalions were issued in General Orders, No. 45, War Department, May 9, 1918. This order provided that there be organized at each National Army, National Guard, and Regular Army divisional camp, and in such other camps as might be directed by the Secretary of War, one or more development battalions.

The functions of the development battalions were to be to relieve divisions, replacement, and other organizations, etc., of unfit men; to conduct intensive training with a view of developing unfit men for duty with combatant or noncombatant forces, either within the United States or for service abroad; to promptly rid the service of all men who, after thorough trial and examination, were found physically, mentally, or morally incapable of performing the duties of a soldier.

The following procedure in connection with the transfer of men to development battalions was to be observed in camps where the establishment of such battalions was authorized: When an enlisted man was inapt or did not possess the required degree of adaptability for military service, or gave evidence of habits or traits of character other than those for which trial by court-martial should be employed that rendered his service in the organization undesirable, or was disqualified for service physically through his own misconduct or otherwise, and not subject to immediate discharge on surgeon's certificate, or was an alien enemy, or who was an alien who was not a declarant and had been drafted through his ignorance of his rights under the selective service law, or for any other reason was not fitted to perform the duties of a soldier at home or abroad, his company or detachment commander was to report the facts to the commanding officer, who was to request that the transfer to the development battalion be made. Soldiers who had not sufficient knowledge of the English language to enable them properly to perform their duties might be transferred to the development battalions, where instruction to the necessary

extent was to be imparted. Within the development battalions the men were to be grouped in classes, depending upon their aptitude and degree of training.

Aside from the statements of organization and functions of the battalions, this order has two outstanding features: First, the provision for both physical and educational treatment of unfit soldiers, thus definitely linking the development battalion with the reconstruction program; second, the failure to separate in any way those physically unfit in line of duty from the venereal cases, the morally or mentally degenerate, alien enemies, draft evaders, and conscientious objectors. Adequate provision of barracks and other accommodations was not made beforehand, and over 98,000 men were transferred to the battalions by August 31, 1918.⁴ These factors, together with the indiscriminate mixing of all classes of men, resulted in a great confusion and a partial failure to effect the results contemplated.

Instructions concerning the operation of development battalions were issued by the War Department early in the summer of 1918.⁵

The purpose of these instructions is to make clear certain points in General Orders 45 and put before all commanders such general principles with reference to the practical working of the order as will insure uniformity in operation and full use of such features as experience has shown to be essential for full success of the plan as a whole.

The basic purposes of General Orders 45 is to relieve divisions and other organizations of all unfit soldiers as soon as encountered, and the reclamation of such men so far as possible in an organization constructed for that special purpose, thereby leaving the division free to function as a machine with perfect members.

It is important, therefore, that General Orders 45 be interpreted broadly and in this spirit. For example, the second paragraph of section 6, stating "Men who * * * will be discharged," should be interpreted to permit a commanding officer to give any form of discharge which in his opinion fits the case.

Soldiers transferred to development battalions will be of two general classes—(a) those transferred to it because of physical disability; (b) those transferred to it on account of all other causes, as stated in section 1, paragraph 4a, and section 2 (G. O. 45, 1918).

When there are more than one development battalion in a camp, each will be numbered as follows: Development Battalion, No. 1, Camp ———; Development Battalion, No. 2, Camp ———; and so on.

The term "rating" is employed in these instructions to indicate the relative military or combat fitness of men. It is not dependent on physical condition alone, which the Medical Department could settle, but involves the consideration of a combination of physical and other causes and conditions having to do with education, training, religion, nationality, etc.

A man's rating indicates the opinion of the development battalion commanding officer, based on a summary of all facts bearing on that man's general fitness. In determining this rating he considers the detailed information furnished by medical and personnel officers as a result of observation and investigation in their respective fields up to the time the man is rated.

The development battalion commanding officer will instruct the personnel officer to enter on the man's qualification card rating 1, rating 2, or rating 3, as the conditions warrant, and the medical officer's remarks or limitations as to the character and amount of work the man may safely be called upon to perform. The personnel officer will thereafter be governed by such rating in making assignments.

Rating 1 is the designation employed to indicate that a man is physically classed by the Surgeon as "A" and that he is considered by the commanding officer satisfactory mentally and morally and from all other standpoints is regarded as acceptable for any character of general military service.

Rating 2 is used to designate those whom the commanding officer regards as hardly suited for rating 1. This includes men classed by the surgeon as physically class "A" yet

found lacking in other respects—as, for instance, of uncertainty of ability to speak, read, and write English, or of slow mentality. It also includes men classed physically as “B”—i. e., “not quite fit for general military service” and free from serious organic disease, but otherwise competent and most desirable. These may be used for any domestic and any but the heaviest combat service (overseas).

Rating 3 designated all those clearly unsuited for ratings 1 and 2, yet of such physical classification (“B” or “C”) that they could be utilized, and whose other characteristics may or may not be of the highest, yet are such as to warrant the retention of these men for restricted or limited domestic service.

The following instructions describe in detail the medical classification to be employed by medical officers, the method of rating, and the report form to be used in transmitting periodic reports of the operation of the battalion.

This development battalion report will be forwarded to The Adjutant General, Committee on Classification of Personnel, Washington, D. C.

As fast as the development battalion reports from the various camps are received by the committee on classification of personnel, they will be tabulated on a summary sheet, which will constitute the consolidated report showing the numbers, classification, and dispositions of all men in all of the development battalions throughout the country.

The purpose of this summary report is to enable The Adjutant General, the General Staff, or others empowered to act to analyze the physical and, to some extent, medical conditions of men rejected from depot brigades and other depots to determine on policy affecting operation of the Army and disposition of such men.

INSTRUCTIONS

1. Soldiers transferred to the development battalion because of physical disability will be from the following sources:

(a) From divisional units, replacement organizations, etc., other than depot brigade. These are men who have been accepted as “fit for general military service,” but in whom a disability has developed or been discovered since “muster in.”

(b) From the depot brigade. These are men who have been accepted for general military service but in whose case observation for a period of from one week to one month has shown that a physical weakness exists which may or may not have been noted on original examination, the nature of the defect making it desirable to transfer the men to development battalion. Probably the majority of these will be men in need of graduated physical training to assure their fitness for general military service. Others will have permanent defects placing them in the group for “special and limited service.”

(c) Registrants, classed by local boards as fit for “special and limited service in a named occupation or capacity,” who are sent to camps as results of calls for this class of men.

(d) Those sent out from other camps and stations under section 1, paragraph 8 (G. O. 45, 1918).

(e) Under regulations at present in force governing the physical examination of men called for general military service, those found by medical officers to be fit for “special and limited service only” or in the class formerly accepted as “fit for general military service when cured of” (naming a specific disability), now the “deferred remediable group,” can not be accepted as in those classes and assigned to development battalions. Such men must be returned to local boards for reclassification unless, in the case of those fit for “special and limited service,” their services are needed in the camp or station at that particular time. If needed at the camp or station, this class may be accepted. If so accepted, they should enter development battalion for rating. All men falling in the “deferred remediable group” must be returned to local boards for reclassification.

2. It is evident that those with whom the cause of transfer to a development battalion is physical disability may be suffering from a variety of pathological conditions. The task of the medical staff is to examine as soon as possible and tentatively classify each man.

All men as they arrive in development battalions will fall into one of the following classes:

(a) Clearly unfit for any service, ready for surgeon’s certificate of disability at once.

(b) Needing hospital treatment at once. These are to be transferred to base hospital or to general hospital.

(c) To enter such special treatment and training as is provided within the development battalion.

3. As treatment and training of men included in Class 2 above, paragraph (c), progresses, each man will ultimately be placed in one of the following physical classes. This is the final classification usually to be made after observation and treatment and training:

Class A. Fit physically for general military service.

Class B. Not quite fit physically for general military service, but free from serious organic disease; able to do an average day's work; able to walk 5 miles; to see and hear well enough for ordinary purposes; able to perform duty equivalent to garrison duty, labor battalion, shop work (in a trade), at home or abroad or combat service at home (United States Guards).

Class C. Fit only for duty in a selected occupation or in a restricted capacity to which they must be limited.

Soldiers in Class C have more serious disabilities and must be considered individually. When it is clear that the physical disability is not of too great severity to exclude him from Class A or B, yet the surgeon believes that this disability is not of too great severity to prevent his retention in the service for duty in a special capacity, he will consult the soldier's "qualification card," note the occupations in which qualified, and direct the personnel officer, as custodian of all personnel records, to indorse on the card in the case of each named occupation the medical officer's opinion as to whether or not the soldier can safely be employed in the named occupations, and whether the disability prevents the soldier being 100 per cent physically efficient in the occupations named on the card. If not 100 per cent physically efficient the percentage of efficiency will be noted. Unless a soldier is 80 per cent or more efficient in at least one trade, he should not be retained in the service.

Class D. Physically unfit for any military service.

Men transferred to development battalions because of causes other than physical disability will also be classified physically at the proper time before being rated.

4. It may be desirable at the end of each month for the surgeon of development battalion to furnish a report to the battalion commander showing the names and the number of men who have been classed physically for assignment during the month just ended. This report should cover and account for all cases in the battalion during the month, showing separately those of Classes A and B, paragraph 1, herewith. The following information should be shown on this report:

(a) Number remaining unclassified physically at end of previous month.

(b) Number received in battalion during the month.

(c) Number disposed of during the month (physically)—

To physical Class A.

To physical Class B.

To physical Class C.

(d) To physical Class D.

(e) Remaining unclassified physically.

5. In each development battalion arrangements will be made for giving physical training to such convalescents as may be sent to the battalion for hardening. Patients who are no longer in need of treatment, but who require hardening before being returned to full duty, may be sent to development battalions by commanding officers of base hospitals or other proper medical officers. They will be carried as attached. At the time they are sent to the development battalion these patients will be returned to a duty status.

When in the opinion of the commanding officer of the development battalion these men have received the necessary hardening, they will be returned to their organizations. Men from base or other hospitals will not be attached to development battalions for physical training unless it is practically certain that they will be able to rejoin their commands within six weeks. If a period longer than six weeks is to be required, the commanding officer of the base hospital or other medical officer concerned should return the patient to quarters at the proper time with recommendation to the organization commander that the

patient be transferred to the development battalion. Commanding officers of development battalions receiving convalescent patients for hardening will take such steps as will insure arrangements by the medical officers of the battalion to the effect that the training to be received by these convalescents is proper, suited to their condition, and that they are not injured thereby.

6. The development battalion is a part of the camp activities, and its medical activities are under the general supervision of the camp surgeon. All communications relating to the medical work of development battalions must pass through the office of the camp surgeon.

7. The medical work of the development battalion will be developed under the immediate direction of the surgeon, depot brigade, if a part of the depot brigade. He will arrange for the assignment to development battalion of a medical officer as surgeon who is especially qualified temperamentally and by experience and training for the work. If no such medical officer is available in the depot brigade and the camp surgeon is unable to furnish one, the needed request will be made to the Surgeon General by wire for the assignment of such an officer. The same general qualifications should be possessed by the officer assigned as assistant surgeon, development battalion. The two medical officers just mentioned are assigned regularly to development battalions and constitute its administrative medical staff. If it is found by experience that additional assistants are required by the surgeon, they may be attached from any junior medical officer available.

8. The necessary arrangements will be made by the camp surgeon to place at the disposal of the surgeon, development battalion, the services of the necessary specialists in cardiovascular disease, tuberculosis, orthopedic surgery, physical training, etc., as may be required. Ordinarily no staff of specialists will be assigned to development battalions, the necessary specialist assistance being obtained from specialist medical officers on duty at the camp and base hospital.

9. It is suggested that separate companies should be set aside to receive those transferred to the battalion because of physical disability, others to receive those transferred to the battalion on account of all other causes. Satisfactory work with these physically unfit men is dependent upon correct physical grading and their assignment to a section of their company in which the work should be given is—

(a) Not too great for their physical powers; and

(b) of such a character that it tends to correct the disability from which a man suffers.

The classification in the companies should be such as to separate the ones who are in need of hospital treatment and those who are so hopelessly unfit as to be proper subjects for immediate discharge. The others should be assigned carefully, the necessary specialist consultants being called in. Following this the man is assigned to a section of the company for training purposes. The organization of these sections can not be laid down in absolute detail. A number of methods may be followed. It is not considered desirable to attempt to make detail regulations on this subject at this time.

10. It is believed that separate accommodations for venereal cases are required in development battalions. Presumably the number of such cases transferred to development battalions will be rather large. This problem may, perhaps, be best met by establishing within the battalions what is, in effect, a unit for the treatment and training of chronic venereal cases. This should have special facilities for administering the necessary treatment, and a course of training should be devised such as will permit the use of the necessary time by the men for going to and from their treatment.

DESCRIPTION OF FORM CCP-601—CAMP DEVELOPMENT BATTALION PERIODIC SUMMARY REPORT AND INSTRUCTIONS AS TO ITS USE

11. The purpose of this report is to present a clear picture of the actual operation of the entire development battalion during the period covered by the report. The report will provide the depot brigade and battalion commanding officers and The Adjutant General with all essential facts to determine the kinds and numbers of men reclaimed and made useful or removed from the Army because past any possible use.

12. The report is to cover one month from 12 o'clock midday of the last day of the month to 12 o'clock midday of the last day of the next month. It must be mailed to The Adjutant General (Committee on Classification in the Army), Washington, D. C., within 24 hours after the closing time.

13. The horizontal headings across the top of the report sheet are clearly stated. Totals of whites, totals of colored, and the sum or total of these are given in each case. The vertical headings down the left side of the sheet are also self-explanatory. Through the use of these crossheadings the report is made to show the actual number and increase or decrease under any horizontal heading—for example, "How many mentally unfit cases were corrected during the month and *rated 2?*" Under the heading "Mental" (15) in horizontal line look down the column until the side heading (9), "Rated 2 since last report" is found. The figure found in the intersecting square will give the actual number of men suffering from some form of mental disability that will include and put into rating 2 for transfer out during period covering the report. Again, "How many colored men with functional heart condition were discharged to Enlisted Reserve (civilian operated plants)?" Under the heading "Functional heart condition," column (16) and side heading (16), "Transferred to Enlisted Reserve" (civilian operated plants) will be found the number, if any, who were so transferred during the month. These examples will serve to indicate method of making up and using the report.

14. A duplicate of each report will be retained for analysis and comparison to insure the battalion performing its purpose of reclaiming the maximum number of men and to prevent the accumulation of permanently unfit and undesirable men.

It will be observed that these instructions made express provision for the transfer of convalescents from base hospitals to development battalions to undergo a hardening process before their return to routine duty. This also released a considerable number of beds in base hospitals which were urgently needed at that time.

A circular published by the War Department at about the same time prescribed that a course of instruction in English be given to those members of each development battalion who had not sufficient knowledge of the language to receive, execute, and transmit verbal messages intelligently, and to read and understand such ordinary written or printed matter as was contained in the various drill regulations, etc.⁶ The normal course was to continue for four months, and the psychological division of the Sanitary Corps would be called upon to assist in determining the rate of progress of slow-learning men and the reason for their backwardness, to the end that all scientific and practical means might be used to determine the best training that should be given those undeveloped mentally as well as educationally.

A large proportion of the men transferred to the development battalions consisted of venereal cases which required treatment but not confinement to a hospital. For convenience, and as an economical measure from the administrative standpoint, buildings were adapted to this special purpose. Plans for a special building for this use were drawn in the Surgeon General's Office.⁷

A board, consisting of a medical officer attached to the division of physical reconstruction of the Surgeon General's Office, a member of the General Staff, and a civilian, was appointed by the Secretary of War on June 10, 1918, "for the purpose of coordinating the work in connection with the establishment of development battalion."⁸ The early plans for the medical phases of the work were entirely in the hands of this medical officer from the date of establishment of development battalions up to September 9, 1918.

The medical and administrative problems arising in connection with the establishment and operation of these organizations were numerous and often involved questions of policy in which several divisions of the Surgeon General's Office were immediately concerned. This complicated matters, and in their earlier stages development battalion activities in the Surgeon General's Office were not so well coordinated as might have been desired. The Acting Surgeon General, therefore, on September 9, 1918, ordered the transfer of the officer in charge of this work in the division of physical reconstruction to the division of sanitation "for the purpose of assuming the duty in connection with the activities of development battalions, the work of which is placed under the direction of the officer in charge of the division of sanitation."⁹ Subsequent to this order all medical activities relating to development battalions were coordinated and directed by the officer in charge of the division of sanitation through the officer in immediate charge of the work.

When the development battalions were transferred to the division of sanitation, immediate steps were taken to organize a group of inspector-instructors¹⁰ composed of specially selected medical officers who were more or less familiar with problems of physical training and reconstruction. Several of these officers were brought together in the Surgeon General's Office, where they were familiarized with all published orders relating to development battalions and with previous plans for these organizations. Solutions were worked out to meet such defects in organization and administration as had already appeared. Information relative to the defects in question was based chiefly upon reports from medical officers in the various camps where battalions already had been formed. The inspector-instructors were then ordered to Camp Meade, Md., where a very efficient organization had been developed. They remained there several days under intensive instruction with the development battalion in that camp. Having been thus familiarized with the work at Camp Meade, they were then ordered to other camps, where they gave instruction using the development battalion at Camp Meade as a model.¹¹ Each inspector-instructor was required to remain at a camp until satisfied that the development battalion was properly organized and equipped and was functioning as intended. Upon the completion of this work he rendered a report to the Surgeon General covering in detail the conditions found by him within the battalion, in so far as this concerned Medical Department activities, and the results of his efforts to improve matters. Twenty-seven camps were visited by these inspector-instructors and in all of them the foundations were laid for efficient development battalions. The main points which these instructors were to convey to the development battalion were:¹² The formation of a board of medical officers and one personnel officer to examine and pass on every case before admission to development battalions; the rapid but accurate final classification of all men in development battalions; a limit of two months was to be fixed as the time men might be held, the need of physical training of the men under the direction and as often as possible the supervision of the medical officers. Since the morale of the men had a decided influence upon their physical and mental betterment, suggestions to improve morale were to be made. Close cooperation between the medical officers and personnel officers was to be established in order to select

duties for the men in the battalion according to their physical and occupational qualifications. The usual period required for discharge for disability for all men placed in D class was to be shortened.

Chiefly through the efforts of medical inspector-instructors, about 15 camps developed very efficient systems in their development battalions before the signing of the armistice on November 11, 1918. The men were more rapidly classified and disposed of than was the case at first, and better cooperation between line and medical officers was secured. Physical development work was established on a proper basis and carried out systematically under the immediate supervision of medical officers. Segregation of the ambulant venereal cases from the remainder of the men in the battalion was accomplished whenever possible. In a number of camps schools for instruction in English were established for the benefit of illiterates and for non-English-speaking soldiers, as well as other schools for special training in occupations useful to the Army. Recreation, games, and other amusements tending to improve morale were promoted and proved of great value. The enrollment in the development battalions during October, 1918, in the more important camps is shown in Table 3.

TABLE 3.—Numerical changes in development battalions during the month of October, 1918¹³

Camp	Remain- ing from previous month	Received during the month	Totals to account for	Dis- charged from the service	De- serted	Died	Rated 1	Rated 2	Rated 3	All trans- fers out of bat- talion	Re- main- ing in bat- talion on Nov. 1
Beauregard, La.	2,993	175	3,171	49	7	56	700	795	406	823	2,233
Bowie, Tex.	160	274	430	18	2	7				2	401
Cody, N. Mex.	974	57	1,026	27	17	3	64	41	95	416	568
Colt, Pa.	249	114	363	20	0	2	79	60	92	94	247
Custer, Mich.	3,294	525	3,819	100	4	25	116	209	21	755	3,235
Devens, Mass.	5,400	2,287	6,576	63	10	9	51	1,734	1,129	1,302	4,186
Dix, N. J.	8,890	4,203	14,093	238	106	62	363	191	105	6,508	7,179
Dodge, Iowa.	4,678	146	4,824	107	0	94	519	219	1,585	1,509	3,314
Doniphan, Okla.	852	84	936	15	0	9	0	0	0	164	839
Fremont, Calif.	2,552	1,493	3,827	333	3	12	371	1,463	849	393	3,086
Funston, Kans.	7,262	1,774	9,036	466	21	113	1,203	1,874	1,034	2,818	5,617
Gordon, Ga.	2,379	886	3,265	230	11	19	80	257	67	194	2,737
Grant, Ill.	7,143	1,480	8,633	987	0	125	186	179	143	2,351	5,170
Green, N. C.	1,836	852	2,688	19	0	69	125	279	200	534	2,110
Greenleaf, Ga.	910	257	1,167	16	2	15	164	319	162	455	679
Hancock, Ga.	832	179	1,011	12	3	4	14	45	16	198	794
Harrison, Ind.	895	405	1,300	36	1	18	48	144	84	501	744
Humphreys, Va.	537	1,126	1,663	0	0	8	55	21	1	3	1,652
Jackson, S. C.	2,540	3,554	6,094	44	20	70	148	489	822	2,097	3,362
Kearny, Calif.	863	338	1,201	67	2	2	26	16	36	196	964
Lee, Va.	6,171	1,079	6,578	229	20	64	312	1,189	971	1,472	5,465
Lewis, Wash.	2,051	291	2,322	19	2	5	76	45	171	260	2,636
MacArthur, Tex.	4,781	308	5,089	326	3	40	17	252	265	763	3,956
McClellan, Ala.	1,871	465	2,336	135	0	5	101	297	150	230	1,966
Meade, Md.	5,507	1,281	6,788	409	17	71	169	631	224	1,294	4,997
Pike, Ark.	0	582	582	120	0	0	17	210	9	88	374
Shelby, Miss.	1,404	14	1,418	32	2	4	0	86	20	442	938
Sheridan, Ala.	1,065	1,065	2,130	50	0	12	0	0	0	520	1,548
Sherman, Ohio.	4,917	1,338	6,235	218	7	135	332	863	847	461	5,556
Travis, Tex.	2,977	422	3,399	104	8	16	205	28	79	460	2,811
Upton, N. Y.	8,634	3,146	11,780	175	56	91	215	272	206	4,951	6,323
Wadsworth, S. C.	1,573	592	2,165	18	8	36	452	30	621	1,512	3,002
Wheeler, Ga.	2,411	2,158	4,569	70	5	2	422	173	567	1,694	3,573
Zachary Taylor, Ky.	4,197	3,493	7,590	173	1	249	18	133	452	1,992	5,673
Total.	101,695	36,115	164,523	4,858	340	1,422	6,199	12,970	10,602	36,165	95,360

All efforts to conserve physically unfit men for military use were terminated by the signing of the armistice; consequently the value of development battalions as such was at an end. Statistics as of November 11, 1918,¹⁴ com-

piled from final reports which are incomplete, indicate that at least 68 per cent (152,807) of the men transferred to development battalions were reclaimed and assigned to some duty in the Army, thus releasing an equal number of able-bodied soldiers for combat service. Without the development battalions the majority of these men would have have been discharged. Table 4 shows the sources of these men from the disease standpoint; Table 5, their dispositions.¹⁴

TABLE 4.—*Classification of men enrolled in development battalions*¹⁴

	Number	Per cent
Venereals.....	77,456	34.5
Orthopedic cases.....	28,823	12.8
Mental conditions.....	4,798	2.1
Functional heart conditions.....	10,917	4.9
Miscellaneous physical.....	53,540	23.8
Non-English, illiterates, morally unfit, conscientious objectors, draft evaders, and enemy aliens.....	33,621	15.0
Not stated.....	15,562	6.9
Total.....	224,717	100.0

TABLE 5.—*Disposition of men from development battalions*¹⁴

	Number	Per cent
Class A (full duty).....	41,450	19.8
Class C-1 (limited overseas duty).....	46,054	22.0
Class C-2 (limited domestic service only).....	42,530	20.3
Total number discharged.....	36,274	17.4
Total deserted.....	919	.4
Total deaths.....	1,356	.7
Not classified.....	40,572	19.4
Total.....	209,155	100.0

CONVALESCENT CENTERS

Following the signing of the armistice a change became necessary in the program of physical reconstruction of disabled soldiers and in the work of development battalions. Previous to this date, development battalions had functioned as outlined above; soldiers discharged from base hospitals, and yet not sufficiently recovered to return to a full-duty status, and soldiers who were physically or mentally unable to continue on a full-duty status were transferred to development battalions where they were made fit for either full duty or limited service.

After the armistice was signed the attention of the medical officers who were concerned with the physical reclamation of our soldiers, was centered upon making the soldier fit to return to civil life as a productive unit of society.

With this in view, the board on development battalions, General Staff, War Department, recommended in November, 1918, that development battalions be utilized to the fullest extent in the disposal of all unfit men, including non-English speaking and illiterates; that immediate steps be taken to curtail discharges on certificates of disability until the aforesaid plan could be put into operation; that the work of carrying out the details of this plan, including the establishment of thorough cooperation with all interested agencies, both military and civil, be delegated to the board on development battalions.¹⁵

On November 25, 1918, the establishment of overseas convalescent detachments was provided for:¹⁶

1. Soldiers who have been or who may be incapacitated while on duty overseas and who are convalescent in this country will not be transferred to development battalions in the future. General Orders, No. 45, War Department, 1918, is hereby modified in accordance with the above.

2. In each camp, cantonment, and post where oversea convalescents may be assembled there will be formed an oversea convalescent detachment. This detachment will consist of such officers, noncommissioned officers, cooks, and other grades of enlisted men as it may be necessary to detail for the purpose of administration, supply, and training, and such convalescents as are sent to the camp, cantonment, or post who have been incapacitated by virtue of having been on duty overseas. The detachment will be quartered and messed separately. While serving in oversea convalescent detachments, men will be carried on the detachment rolls in the grades held by them in their permanent organization.

3. In order to relieve congestion in general hospitals, commanding officers of such hospitals are hereby authorized to send oversea convalescents, whose hospital treatment has been completed, to oversea convalescent detachments in the following camps: Beauregard, Custer, Devens, Dix, Dodge, Funston, Gordon, Grant, Hancock, Jackson, Kearny, Lee, Lewis, MacArthur, McClellan, Meade, Logan, Pike, Sevier, Shelby, Sherman, Sheridan, Taylor, Travis, Upton, Wadsworth, and Wheeler.

Since it is the intention to discharge all oversea convalescents as soon as possible, consistent with the maximum physical improvement, commanders of general hospitals will, as far as practicable, send convalescents to the camps nearest to the homes of the men to be discharged. Intensive treatment and training of all convalescents assembled in oversea convalescent detachments will be immediately undertaken and continued in order that their cure or maximum improvement and subsequent discharge may be accomplished in the shortest possible time. On the last of each month commanders will report to The Adjutant General of the Army the number of men received in and the number of men discharged from oversea convalescent detachments.

4. Commanding officers, upon whom the duty of organizing oversea convalescent detachments devolves, should bear in mind the importance of the work to be performed in these detachments. It is only by the selection of competent line and medical officers and thorough cooperation on the part of these that the best results can be obtained. The object sought is the return to civil life of these men in the best physical and mental condition.

5. Convalescents whose treatment and training has been completed will be promptly discharged in accordance with existing instructions without reference to the War Department.

Since the above provisions (Circular No. 90) concerned oversea convalescents only, and since the base hospitals in the United States contained many patients who never had served overseas but who were in need of convalescent camp care, the Surgeon General, in December, 1918, recommended that convalescents from the forces in this country be given the same care as oversea convalescents, in order that they might be returned to civil life in the best physical and mental condition attainable.¹⁷ Accordingly, Circular No. 90 was so modified as to include all convalescent soldiers from general and base hospitals, and the designation "oversea convalescent detachments" was changed to "convalescent centers." Since these instructions contained many interpretations concerning the discharge of disabled soldiers, which are of present interest, they are reproduced here in full:¹⁸

1. In order that the provisions of paragraph 2, Section II, Bulletin No. 36, War Department, 1918, may not unduly retard the discharge from the service of men clearly unfit for military service, the following interpretation of the spirit of this paragraph is published:

(a) Subparagraph (a) is intended to provide for the complete cure or maximum restoration of men incapacitated because of military service. Subparagraph (b) is intended to

provide for the retention in the service of such disabled men until such time as their maximum restoration has been obtained. There will be many cases that will not be benefited by further sojourn in hospitals, convalescent centers, or development battalions. These should be promptly discharged. The surgeon who has the case in hand must be the judge as to whether or not maximum restoration has been secured, or if, after treatment in the hospital in which the patient is located is completed, the case will be further benefited by transfer to another hospital, convalescent center, or development battalion. Cases which, in the opinion of the surgeon, will be further benefited should be promptly transferred.

There will, furthermore, be many cases of disabled men who either possess funds or who have relatives or friends in position to afford them specialized care after discharge. In these cases disabled men may be discharged but not until the responsible commanding officer has fully determined that continued treatment and care is assured. The fact that a man (his continued treatment and care being assured) is being discharged, either at his own request or at the request of the relative or friend, will be noted on the report rendered in connection with the soldier's physical examination prior to discharge. This notation will include the name and addresses of the persons assuming responsibility for such continued treatment and care.

The provisions of paragraph 2, Section II, Bulletin No. 36, War Department, 1918, as interpreted above, will govern both for officers and enlisted or drafted men. In this connection, convalescent centers and development battalions are intended for enlisted or drafted men only.

(b) The provisions of paragraph 1, Circular No. 93, War Department, 1918, intend that the cases of all men who have acquired a lower physical standard than that given them when they entered the service, shall be promptly acted upon by the Board of Review in order that men may be discharged immediately after the Board of Review certifies that the maximum improvement has been obtained or that physical disabilities have not been exaggerated or accentuated as a result of service in line of duty. Instructions on page 4, Form No. 135-3, A. G. O., should be harmonized accordingly.

2. During the demobilization of the present army commanding officers of general hospitals will dispose of patients in such hospitals who are enlisted or drafted men as follows:

(a) Men who entered the service since April 1, 1917, and who after hospital treatment are fit to return to full duty, will be sent for discharge to the demobilization center nearest their place of entrance into service as indicated in Circular No. 106, War Department, 1918, amended by Circular No. 122, War Department, 1918.

(b) Men without regard to date of entry into the service who have since become disabled or who had disabilities prior to their entrance into the service which have been aggravated or made worse by service, said disabilities not being due to their own misconduct, will be transferred to convalescent centers as prescribed in Circular No. 90, War Department, 1918, amended by Circular No. 183, War Department, 1918, providing further benefit can be expected by additional treatment, training, and hardening processes.

(c) Men without regard to date of entry into the service who have become disabled either prior to or since entry into the service, due to venereal disease, and who need further treatment but do not necessarily require hospital care, will be transferred to the development battalion nearest their place of entrance into service.

(d) The cases that can not be benefited by further treatment in hospitals or by transfer to convalescent centers or development battalions will be discharged on Form No. 17, A. G. O. (certificate of disability), in accordance with existing conditions. Existing instructions will govern in the discharge of all cases of disability due to their own misconduct.

(e) Men who entered the service on or before April 1, 1917, who become fit for full duty, will be returned to their organizations if said organizations belong to the Regular Army and are stationed in this country. All other such men, except those belonging to the Cavalry and those whose branch of service is not represented in the Regular Army, will be sent to the nearest appropriate units of the 8th to 20th Divisions, inclusive, or to the nearest appropriate unit in the Regular Army in the United States not in those divisions. The names of such enlisted men in the Cavalry will be reported to the commanding general, Southern Department, for assignment. Those whose branch of service is not represented in the Regular Army

will be sent to the nearest depot brigade. Men of these classes transferred will be assigned or attached to appropriate organizations in their present grades.

(f) Commanding officers of general hospitals are authorized to transfer direct the cases enumerated in subparagraphs (a), (b), (c), and (e) above and such other cases as may need treatment which can be given only in another hospital.

3. Whenever Form No. 17, A. G. O., is used in lieu of Form No. 135-3, A. G. O., a carbon copy will be prepared and transmitted to the Bureau of War Risk Insurance, as provided for in paragraph 2, Circular No. 73, War Department, 1918.

4. The designation "oversea convalescent detachments," as provided for in Circular No. 90, War Department, 1918, is hereby changed to "convalescent centers." They will be used as concentration points not only for oversea convalescents but for convalescents from the forces in this country, including the few remaining cases in development battalions whose disabilities are not due to their own misconduct. The quarters selected for convalescent centers should be selected in an attractive part of the camps, and whenever practicable should be near the various welfare centers conducted by the Young Men's Christian Association, the American Red Cross, and other civilian organizations.

5. In view of the signing of the armistice and of the above provisions, the necessity for development battalions as organized under General Orders, No. 45, War Department, 1918, ceases to exist except for the further treatment of venereal cases and for men held for reasons other than physical disability who are awaiting discharge. Experienced personnel no longer needed in development battalions should be utilized in convalescent centers. In this connection, as stated in paragraph 4, Circular 90, War Department, 1918, it is only by thorough cooperation on the part of line and medical officers that the best results can be obtained. The results desired are the maximum restoration of these men in the shortest time possible. Therefore, the assignment to physical drill, exercises, fatigue, the granting of passes or furloughs, etc., should be made only after consultation between the responsible line and medical officers.

Following the promulgation of this order, the Surgeon General placed the supervision of medical work in convalescent centers under the division of physical reconstruction of his offices. To establish a general policy of the reconstruction division in the camps, the Surgeon General issued instructions in January, 1919, as follows:^{19 20}

The policy approved by the War Department, which embraces the application of curative work and efficient physiotherapy in the treatment of sick and wounded soldiers, implies that this is to be carried on in the hospitals to hasten the restoration of disabled officers and soldiers to health and function as fully as possible, considering the nature of their disabilities, the limitations of their military service, and the other provisions which the Government has made for the care of the permanently disabled.

When the disabled soldier shall have received the treatment embraced in paragraph 9, he, by virtue of paragraph 4, Circular 188, W. D., should be discharged from the hospital and sent to the convalescent center. The soldier sent to the convalescent center is on a duty status and is therefore not a patient. He should therefore be in such condition when he is sent to the convalescent center as will justify his discharge within a few days or in a short period of time for the purpose of receiving exercise, drill, and appropriate play which will harden him and overcome as far as possible defects which are amenable to the measures which may be utilized in the convalescent center. Circular 188, W. D., indicates the location of convalescent centers in camps and contains general statements concerning their administration from a medical point of view.

In the administration of the curative workshop schedule and the utilization of physiotherapy in the base hospitals, it is suggested that the camp surgeon may utilize both curative work and physiotherapy for the convalescent soldiers on duty in convalescent centers by sending them to the workshops and physiotherapy rooms for such treatment as the medical personnel of the convalescent center may desire to be applied.

* * * * *

That the administration of the curative workshop schedule may be as efficient as possible for all disabled men who may be benefited thereby, it is suggested that the convalescent center be located as near as possible to the base hospital.

While it is appreciated that the actual medical and surgical treatment of the men in the convalescent center will have been practically completed in the hospitals before they are assigned to duty in the convalescent centers, many of these men will need rehabilitation and a hardening process to improve their general morale and physical condition before they are recommended for discharge. This hardening process may be best obtained by supervised graduated physical exercises, drills, games, and, when necessary, by the utilization of the curative workshops in the educational center. Soldiers who may benefit by academic studies should be given this opportunity under the supervision of the chief educational officer and in this way may continue this study which was begun when the soldier was in a base or general hospital. The War Department commission on training camp activities has agreed to furnish the necessary physical directors and equipment in the recreational activities of the convalescent center. The American Red Cross, cooperating with the Young Men's Christian Association, the Knights of Columbus, the Salvation Army, and the Jewish Welfare Board, will furnish recreational activities in the base hospital and agencies which will stiffen the morale of the men by home service activities through local Red Cross chapters and other facilities which they command.

Several medical officers were directed to report to the reconstruction division, Surgeon General's Office, with the view of receiving instruction in the work of medical administration of convalescent centers and of acting as instructor-inspectors.²¹ At Camp Dix, N. J., a convalescent center had been established and now was operating efficiently, so this group of instructor-inspectors was sent to that camp where several days were spent in studying the convalescent center.²¹

The reconstruction division of the Surgeon General's Office endeavored to set forth general principles relative to medical work in convalescent centers and in the connection of this work with the whole physical reconstruction program in the base hospitals.²¹ The medical administration of the centers necessarily was left to camp surgeons, since the men in the centers were on a duty status. As a result, each camp had some distinctive feature in its convalescent center, but, on the whole, three types of centers were developed.²¹

The first type of convalescent center comprised those established in a part of the camp which was some distance from the base hospital, adjacent either to the recreational center or the existing shops of the camp. In such a center an educational system or curative work schedule was established independent of that conducted at the base hospital.²¹ The automobile shops, carpenter shops, telephone offices, and other activities of the camp were utilized for educational purposes. Usually a director for this work was found among members of the Young Men's Christian Association; otherwise, line officers were assigned to this duty by the commanding officer.²¹ Massage and other forms of physiotherapy were applied in the center. The physical development of the men in the center was carried on by the director assigned to this work by the War Department commission on training camp activities.²¹ The surgeon of the convalescent center usually divided the convalescent soldiers into groups A, B, and C, according to their ability to perform physical exercises.²¹ Thus, Group C men could have only light exercises for one or two hours a day; Group B men were able to have a moderate amount of exercise for three or four hours a day; group A men could have strenuous exercise several hours

a day, since they represented men undergoing their final training preliminary to their discharge from the Army. As the convalescent soldiers developed strength and hardening, they were promoted from Group C to Group B, and thence to group A for discharge in the depot brigade, after being finally passed on by the local medical demobilization board. If in the judgment of this board the maximum physical restoration had been attained, the men were discharged; otherwise they were returned to the convalescent center for further treatment and training. Examples of this type of convalescent center were in Camps Dix, N. J., Gordon, Ga., and Kearny, Calif.²¹

The second type of convalescent center comprised centers which were established as near as possible to the base hospital.²¹ Some of these convalescent centers used the curative workshops in the base hospital, and the educational activities established there; in others, workshops and educational courses were established in the center itself.²¹ All of this work, however, was under the immediate direction of the chief educational officer of the base hospital. Very little medical treatment was carried on in these centers, the convalescent men who needed further treatment being referred back to the base hospital as out-patients. In this type of camp, it was the custom for the ambulance from the hospital to carry a certain number of the convalescents to the base hospital each day, for either treatment or curative work, since it was the rule for the soldiers to go to the physiotherapy center in the base hospital for this form of treatment. The training under the physical director of the center was somewhat similar to that described under the first type above. When ready for discharge, the soldiers were referred to the local medical demobilization board. Examples of this type of center were at Camps Meade and Lee.²¹

The third type of convalescent center, fortunately only a few in number, functioned more as a demobilizing center than as a convalescent center, and very little effort was expended in educational or curative work or in physical development.²¹ The convalescents were sent, after a few days in camp, to the medical demobilization board for action by the board, looking to immediate discharge.²¹

With the view of securing uniformity in the convalescent centers, the Surgeon General on January 25, 1919, issued the following instructions to consultants and instructors in convalescent centers:²²

1. Consultants and instructors in convalescent centers should visit the camps for the purpose of establishing the general policy of the division of physical reconstruction as outlined in various circular letters.

2. From the circulars it is seen that the curative workshop schedule should be centered under one administration applicable to both the patients in the base hospital and to the men in the convalescent centers. It should be your endeavor to influence the authorities in the camps to place the various shops and other trade activities at the disposal of the educational officers in the base hospital. By your efforts you can further influence the proper cooperation and coordination between the line and the medical officers of the convalescent center, the educational officer of the base hospital, the physical director of the training camp activities, and the various recreational camp activities, all with the view of stimulating the general morale and upbuilding of the men in the convalescent centers.

3. It is evident that the educational work started in the hospital should be a continuous process for those men in the convalescent centers who need this form of training. You should therefore ascertain if arrangements have been made for their attendance in the shops and schools established in the base hospital or located elsewhere in the camp.

4. One of the chief functions of the consultants and instructors in the work of convalescent centers is to observe carefully from every standpoint the end results which are being obtained and to report to this office concerning the same, with any suggestions for their improvement.

During January, 1919, 17,439 soldiers were admitted to the 19 convalescent centers, and 10,210 of these were discharged within two weeks.²¹ Reports from all camps showed only 145 men who remained in the centers for more than six weeks during the first two months of their operation,²¹ which raises the question as to the probable value of the curative workshop schedule in such centers, other than as a means of occupying time, when the length of the courses was necessarily so short. Thirty-five thousand soldiers passed through the convalescent centers in February and March, 1919, and only 6,000 in April.²¹ Certain centers were abolished from time to time as the need in a particular locality declined, and in the latter part of April the War Department authorized the demobilization of convalescent centers by camp commanders, when the functions of an existing convalescent center could be taken over with advantage by the base or camp hospital.²¹

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- (2) Letter from The Adjutant General to commanding generals of all Regular Army, National Army, and National Guard divisions, March 8, 1918. Subject: Rehabilitation of the physically unfit. Copy on file, Record Room, S. G. O., 353.91-1.
- (3) Letter from Lieut. Col. E. G. Brackett, M. C., to the Surgeon General, March 22, 1918. Subject: Physical training organizations. On file, Record Room, S. G. O., 353.91-1.
- (4) Report of development battalions made to the Surgeon General by the chief of the division of physical reconstruction, August 31, 1918. On file, Record Room, S. G. O., 322.171-1.
- (5) Instructions concerning operations of development battalions, issued by the War Department, undated. On file, Record Room, S. G. O., 322.052.
- (6) Letter from the Surgeon General, United States Army, to Major Lantz, General Staff, War Department, Washington, D. C., August 8, 1918. Subject: Development battalions (and attached papers). On file, Record Room, S. G. O., 322.171-1.
- (7) Plans of venereal infirmary for development battalions, August, 1918. On file, Record Room, S. G. O., 322.171-1.
- (8) S. O. No. 135, W. D., June 10, 1918.
- (9) Office Order No. 84, S. G. O., September 9, 1918.
- (10) Letter from the Acting Surgeon General to camp surgeon, Camp Meade, September 21, 1918. Subject: Medical personnel for development battalions. On file, Record Room, S. G. O., 210.3 (Camp Meade) (D).
- (11) Report of sanitary inspection, Camp Meade, Md. On file, Record Room, S. G. O., 721.5 (Sanitary Report).
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- (13) Development battalion summary report, November 1, 1918, prepared in the division of sanitation. On file, Record Room, S. G. O., 322.171-1.
- (14) Report on development battalions and limited service, by Col. Harry E. Mock, M. C., undated. Copy on file, Historical Division, S. G. O.

- (15) Memorandum from chief operations branch, General Staff, for Chief of Staff, November, 1918. Subject: Development battalions and their part in demobilization. Copy on file, Record Room, S. G. O., 322.171-1.
- (16) Circular No. 90, W. D., November 25, 1918. Subject: Oversea convalescent detachments.
- (17) Letter from The Adjutant General, United States Army, to the Surgeon General, December 19, 1918. Subject: Modified program of physical reconstruction (and attached papers). On file, Record Room, S. G. O., 353.91-1.
- (18) Circular No. 188, W. D., December 31, 1918.
- (19) Circular Letter No. 29, Surgeon General's Office, January 14, 1919.
- (20) Circular Letter No. 33, Surgeon General's Office, January 18, 1919.
- (21) Report on convalescent centers, by Lieut. Col. Harry E. Mock, M. C., undated. On file, Historical Division, S. G. O.
- (22) Memorandum from the Surgeon General's Office, for consultants and instructors in convalescent centers, January 25, 1919. On file, Historical Division, S. G. O.

SECTION V

MORALE WORK; WELFARE ORGANIZATIONS

CHAPTER IX

MORALE WORK AS AN AID TO RECONSTRUCTION

GENERAL ASPECTS

To assure the successful prosecution of the war, it was necessary to develop the morale of both the public and the soldiers to a high level which would insure the united effort of every faction, community, and interest of the whole country. To assure the success of the reconstruction program, similar efforts were essential in order that the whole country should understand the benefit expected to the individuals treated and to the civil community. To this end, publicity, recreations for patients, social-service work in its broadest sense, and governmental assurance of vocational assistance for the disabled and of financial assistance for their dependents were necessary. The latter was furnished by the functions of the Bureau of War Risk Insurance and the Federal Board for Vocational Training; the other requirements were furnished by various agencies. Eventually, all these activities were directed and coordinated by the morale officer of each hospital, but this stage was attained only after a gradual development of the morale work.

The earlier aspects of the work concerned primarily the education of the public in the proposed reconstruction program of the Surgeon General's Office, provision for which was made by the creation of the "section of educational propaganda" in the division of special hospitals and physical reconstruction.¹ Newspaper publications covering the general idea, the presentation of accounts of reconstruction work in the Allied Armies before meetings of professional men and similar accounts in a series of bulletins published by the Surgeon General's Office, and hundreds of thousands of leaflets distributed by the American Red Cross were the means employed to prepare the ground for the later acceptance of the public and the active participation of the medical profession when the matured plans should be ready for submission. Provision was made for the continuance of this work when the division of reconstruction, Surgeon General's Office, was recognized in May, 1918, by the creation of a section for the "education of the public and of the military service."² The most notable single instance of this publicity was the devotion of an entire day at the annual meeting of the American Medical Association in June, 1918, to the reading and discussion of papers on the subject of reconstruction in all sections of the meeting.

This educational effort was necessarily of a general nature during the formative stage of the reconstruction plan and pending its approval.

PUBLICATIONS ON RECONSTRUCTION

CENTRAL MEDICAL DEPARTMENT PUBLICATIONS

The *Official Bulletin* was a daily paper published by the Committee on Public Information by order of the President, and the first detailed account of the reconstruction plan was published in the issue of August 1, 1918.³ A publication was desirable which would be devoted entirely to the success of reconstruction. As there was no authority by which the Surgeon General's Office could maintain such a publication, arrangements were made by which that office supplied the material for publication and the American Red Cross paid publication expenses. This pamphlet was entitled *Carry On*, the first number appearing in June, 1918.⁴ Its purpose was to explain, primarily to disabled soldiers and sailors, the advantages to be derived from reconstruction and the ideals toward which they should struggle, and to endeavor to inculcate in each individual a determination to "carry on," both during the remainder of their military service and afterwards in civil life.

Articles which were officially accurate were furnished to the newspapers in the effort to get the solid support of the entire country behind the reconstruction plan, for the success of the work would have a great effect in increasing the general morale; its success would depend, to a large extent, upon the influence wielded by relatives and friends of the disabled, for if a father could not perceive the advantages in reconstruction his disabled soldier son would very probably refuse to avail himself of the opportunity.

HOSPITAL PAPERS

The need for hospital newspapers developed in the military hospitals even before the introduction of reconstruction. The first one to appear was the *Ontario Post*, first published by General Hospital No. 5, Fort Ontario, N. Y., August 11, 1917. The next to appear was *The Trouble Buster*, at General Hospital No. 2, Fort McHenry, Md., April 23, 1918, and this was the first publication of any kind in the whole country which was devoted exclusively to reconstruction work. General Hospital No. 12, Biltmore, N. C., published the first number of *The Ward Healer* in May, 1918, and the base hospital at Camp Upton followed in June, 1918, with *The Cure*.

After these pioneer publications there followed in rapid succession weekly newspapers in the various Army hospitals throughout the country.⁵ The total number of these publications to April 23, 1919, was 35.⁵ The combined circulation of all the hospital papers was 140,000 copies per week. The circulation of the various papers varied from 500 to 30,000 per week. The usual size, however, was from 1,500 to 4,000 copies weekly.⁵

The following were some of the important purposes subserved by the hospital papers:⁵ They constituted an effective means of carrying important messages and information to members of the hospitals and commands; they proved to be one of the most powerful agencies in raising and maintaining the morale of the patients and enlisted personnel; the editing and printing of the hospital papers made a most interesting and profitable school for the training

of disabled men for the newspaper and printing business; the newspapers became important instruments for furnishing information concerning the hospitals to relatives and friends of the men and to the public in general.

In most cases the hospital papers were self-sustaining. They were put upon the news stands and sold upon the streets. The overhead expenses being moderate, the income from the sales was directly applied to the bills for actual materials. In a few cases, as for example, *The Trouble Buster*, the paper was supported from special funds and circulated without charge.⁵ Some of the hospitals had print shops equipped with linotype and monotype machines, presses, cutters, etc., sufficiently complete to print their own papers. In other cases the papers were printed by contract with commercial publishers.

The equipments for the hospital print shops were provided largely from funds furnished by the division of physical reconstruction, but in some instances almost the entire equipments were supplied early in the work by private individuals and firms interested in the reconstruction work.⁵

In order to keep all these publications going, a considerable force of patients, enlisted personnel, and officers was necessary in every hospital publishing a paper.⁵ The disabled men desiring to learn any part of the printing or newspaper business were placed on the actual jobs in the print shops, working with and under the supervision of skilled men in their special fields. While some men were actually learning the operation of linotype and monotype machines, printing presses, etc., others were being instructed in editorial, reportorial, illustration, and other lines of newspaper work.⁵

The department of publicity in the Surgeon General's Office had a force of experienced newspaper men, special writers, artists, etc., who prepared material of all kinds and furnished it to the various papers.⁵ This centralized and systematized the efforts and assured a representative body of material of a general nature for all the papers.⁵

MORALE OFFICERS APPOINTED IN HOSPITALS

The necessity for closer supervision of the morale work in hospitals becoming evident about the time of the signing of the armistice, the Surgeon General, on December 3, 1918, directed each base hospital commander to appoint an officer from his staff to act as an agent of the camp morale officer within the hospital.⁶ This activity was extended to all hospitals conducting the educational feature of reconstruction in February, 1919, with the additional proviso that the chief educational officer should be designated as morale officer for the hospital.⁷ With the necessary assistants, he was expected to assure and coordinate the provision of amusements and recreations for all personnel in the hospital, or any other activities which would promote their contentment, and to provide such instruction as was considered to be advisable in raising their standards of moral and physical living.

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- (3) *Official bulletin*, ii, No. 375, 1918. Copy on file, Historical Division, S. G. O.
- (4) Copy on file, Historical Division, S. G. O.
- (5) Report on newspapers in United States Army General Hospitals, by Lieut. S. J. Vaughn, S. C., publicity officer, division of reconstruction, Surgeon General's Office, undated. On file, Historical Division, S. G. O.
- (6) Letter to commanding officers all camp base hospitals, Surgeon General's Office, December 3, 1918.
- (7) Circular Letter No. 67, Surgeon General's Office, February 1, 1919.

CHAPTER X

WELFARE ORGANIZATIONS—THEIR RELATIONSHIP TO RECONSTRUCTION

The activities of the welfare organizations, as a whole, were almost entirely confined to morale work, the supply features of the American Red Cross making it the one outstanding exception. However, for convenience of description, all welfare organizations are included here.^a

AMERICAN NATIONAL RED CROSS

The American National Red Cross was the only civilian association authorized by law to supplement the resources and to assist the personnel of the Medical Department in time of war,¹ but the services of other civilian organizations could be accepted when such services were supplied through the medium of the American Red Cross.² The President of the United States formally accepted the offer of cooperation and assistance from the American Red Cross July 5, 1917.³

EARLY PARTICIPATION IN RECONSTRUCTION

The first records of participation of the American Red Cross in the reconstruction work are those of various instances of assistance to the Surgeon General's Office in the selection of personnel for special positions, particularly women. This function became organized when the American Red Cross furnished an employee in January, 1918, as an assistant to the supervisor of medical aides in selecting women to fill the positions offered.⁴

Preliminary plans for assisting in the reconstruction work were considered in October, 1917, before the plans of the Surgeon General had been submitted to the Secretary of War.⁵ The home service section of each local American Red Cross chapter was expected to undertake these four main lines of work:⁵ (a) The coordination and utilization of all vocational training agencies and other institutions and organizations in each community which could be of advantage to the disabled soldier, either in extending or in modifying his preparation for self-support; (b) the establishment of an employment agency and the awakening of a genuine interest on the part of employers, so that these men would have every opportunity for self-support; (c) special personal attention to the men themselves, that they might be encouraged to continue their work until refitted to industry, when they had not by their own efforts succeeded in finding fit opportunities for work that they were able to do; (d) the cultivation of a public opinion which would discourage improvidence and the willingness to be supported at public expense, no matter how distinguished their services or what their disability, if and when they were capable of self-support.

Plans were made for an institute in New York City which would be available for the rehabilitation of crippled soldiers, and it was ready for their recep-

^a No records of the war-time activities of the Knights of Columbus and of the Salvation Army are available—*Ed.*

tion before there were any war casualties in the Army.⁶ The institute was therefore utilized for training cripples from civil life, and the difficulties encountered led to extensive investigations of the entire subject, educational efforts for the benefit of the public, and intensive training of teachers in this type of work.

FORMAL OFFER OF ASSISTANCE IN RECONSTRUCTION OF WOUNDED SOLDIERS

In December, 1918, American Red Cross headquarters offered its service in the reconstruction of disabled soldiers to the Surgeon General as follows:⁷

It has for several months been our hope and expectation that the Red Cross, with its nation-wide network of well-organized local committees, might be called upon to discharge certain appropriate functions in connection with the aftercare of disabled soldiers and sailors following their physical reconstruction and vocational reeducation in the institutions under your direction. You will of course understand that the Red Cross desires to act in this matter in the fullest cooperation with the official plans of the Government. Inquiries now beginning to come in from our division and chapter offices indicate rapidly growing interest in the subject of the aftercare of disabled men and anxiety as to the duties that Red Cross local chapters will be called upon to perform. If you find it desirable to give us at this time some preliminary indication of the share which the Red Cross will be asked to take in the national program for the reconstruction of wounded soldiers it may be possible with great advantage to make a definite announcement in the *Manual of Information* above described which we are just now preparing for the press.

In such preliminary consideration as we have given this matter it seems to us that the Red Cross will be in a particularly advantageous position to cooperate in your plans, by reason of the fact that in each of our local chapters there is a home-service section with trained executive workers who will have had the families of many soldiers under their friendly care and assistance during the war. For these reasons, the Red Cross chapters throughout the country will be especially fitted to participate in the work of readjusting to civil and industrial life the discharged soldiers returning to their communities, and to foster public sentiment among employers, among the men themselves, and with the public at large, which will facilitate the most prompt and effective absorption of these men and will offset the danger of their becoming a burden on the community.

We are prepared to print and distribute another special handbook for the instruction of our chapters regarding their duties in the program of the aftercare of disabled men as soon as you indicate the part which it is desired that the Red Cross undertake in connection with the Government's program.

In January, 1918, the American Red Cross was represented at the conference of various departments interested in reconstruction which met to coordinate the work.⁸

ACTIVITIES AUTHORIZED IN HOSPITALS

Certain activities of the American Red Cross were authorized by the War Department in February, 1918,⁹ of which the following extracts apply to hospitals:

* * * * *

2. To render emergency relief of every kind upon the request or suggestion of an officer in charge. All officers are instructed to avail themselves of this assistance whenever, in their opinion, advisable. Officers should be none the less diligent in attempting to foresee the needs of their department in order that they may be supplied through regular Government channels. All such requests must be approved by the commanding officer, who will cause a record to be kept of all such articles.

3. To relieve the anxiety and to sustain the morale of soldiers who are worried about their families at home and to promote the comfort and well-being of these families, authority is given to the American Red Cross to place one or more representatives of the home-service bureau of the department of civilian relief at the service of the men of each division of the Army wherever located. The soldiers should be informed through official orders of the presence of such representative or representatives and that the Red Cross is able and willing to serve both soldiers and their families when in need of any helpful service. This representative and his assistants will be accredited to the division commander and will be subject to his authority and to military laws and regulations. This representative of the Red Cross will have the status of an officer in the Army and will be provided quarters when available. Such assistants and clerks as may be necessary will be provided by the American Red Cross and must be males. These assistants and clerks, if any, will have the status of noncommissioned officers. All reports and correspondence of this office will be subject to censorship of the commanding officer.

* * * * *

5. A representative of the American Red Cross may be attached to each base hospital to furnish emergency supplies when called upon, to communicate with the families of patients, to render home service to patients, and such other assistance as pertains to Red Cross work. The representative of the Red Cross so assigned, together with his assistants, will be accredited to the commanding officer of the base hospital, and will be subject to the same regulations as to status, privileges, assistants, and censorship as provided in preceding paragraph applying to the representative of the Red Cross assigned to division.

* * * * *

8. The commanding generals of all cantonments and National Guard encampments and the commanding officers of all other encampments or organizations with this order are authorized to furnish to the American Red Cross anything that they may request within reason, such as warehouses, offices, light, heat, telephones, etc., in order to enable them to properly carry on the work for which they are assigned.

In the development of a large number of educational centers in base hospitals under conditions of greatest possible haste and urgency it was often difficult to secure personnel, equipment, or supplies rapidly enough through Army channels. Supplies which hospitals could not obtain promptly through military channels were furnished by the American Red Cross under the above authority, and various services rendered in innumerable instances which were so common place at that time that they are not mentioned in reports, but often were of extreme importance. The term "supplies" sometimes included machinery or other articles of considerable value, and it became necessary to regulate such matters to a certain extent. An agreement was published in May, 1918, under which such gifts from the American Red Cross were to be officially accepted by the Surgeon General's Office and thereby became the property of the Government.¹⁰

The American Red Cross used its funds generously in procuring workers, supplies, and equipment. It did this in local posts upon the arrangements made with local officers of the American Red Cross, and, also, in a more general way for all posts, through the Surgeon General's Office.¹¹ An illustration is the educational officer's emergency fund of \$200 per month. This fund was to be expended by the chief educational officer for items of supplies, equipment, and service needed immediately and not readily procurable from Army supplies or funds. Items procurable in a longer time from Army sources, but whose usefulness would be seriously impaired by the time necessary to secure them from Government sources, were procurable with the funds. The educational officer

incurred the obligations and they were paid by the American Red Cross officer upon draft made by the educational officer. Accounts were carefully reported and audited both by the Surgeon General's Office and by the American National Red Cross. This fund often procured the lesser items which made immediately available much larger and more extensive equipment from Army sources. It was seized upon eagerly by educational officers as the thing which made possible more rapid and efficient establishment of the service.¹¹

The question of uniforms for the reconstruction aides who were being sent overseas was raised during the fall of 1918. As these women were not receiving large pay, the American Red Cross undertook to furnish certain articles of uniforms and equipment free and others at cost.¹²

The Red Cross published the *Educational Officers' Handbook*, with the approval of the Surgeon General's Office, which was a detailed and methodical description of the duties of educational officers and their relations to the other departments of the hospital, and was of particular value for inexperienced educational officers.¹¹

It outlined the field for educational officers as being the general supervision of all recreational activities, and contained some very pertinent suggestions which show well the general spirit of the whole movement. It was suggested therein that the chief educational officer call a conference of the representatives of the American Red Cross, Young Men's Christian Association, the Knights of Columbus, the American Library Association, the Jewish Welfare Board, all volunteer agencies and individuals willing to assist in the work at the particular post. At this conference each agency outlined its own plans and purposes, and a unified cooperating program was the result.

HOSPITAL SERVICE

The field director visited the wards and acquainted himself with any wants either of the institution or the individual patients.¹³ Many occasions had arisen where the bureau of camp service had been able to supplement the hospital supplies at the camps, to the end that the sick and convalescent might be made more comfortable.¹³ The fact that the American Red Cross was a volunteer organization made it possible for it to act in such emergency with a speed and freedom impossible to a governmental department.¹³

The American Red Cross, by request of the War Department, undertook to supplement the regular hospital service by extra attentions to the sick and wounded.¹³ Daily visits were made to each patient, so far as practicable, and those services rendered which were not possible for the attending doctors or their aides. This visiting was done by the associate field director and his assistants, and often by women from near-by American Red Cross chapters, under the supervision of the associate field director.

With the heavier fighting on the Western Front and the several outbreaks of contagious diseases which occurred in the United States and immediately affected the camps and camp areas, the American Red Cross hospital service materially increased its activities.¹³ The lines of service which had defined themselves by July 1, 1918, were maintained intact during the whole of the

year. The regular work for the sick in the wards, for the convalescents, for the personnel of the hospital, and the communication service and emergency service were maintained in increasing measure.

Visiting in the wards was amplified at many of the hospitals by enlisting the service of selected women volunteers from near-by chapters. These volunteer visitors were organized into squads, with the object of having a visit paid to practically every patient every day.

On January 26, 1918, the Secretary of War requested the American Red Cross to extend the communication service which it had in operation abroad to the Army hospitals in this country.¹³ In several instances commanding officers of hospitals in the United States turned over a large part and in other

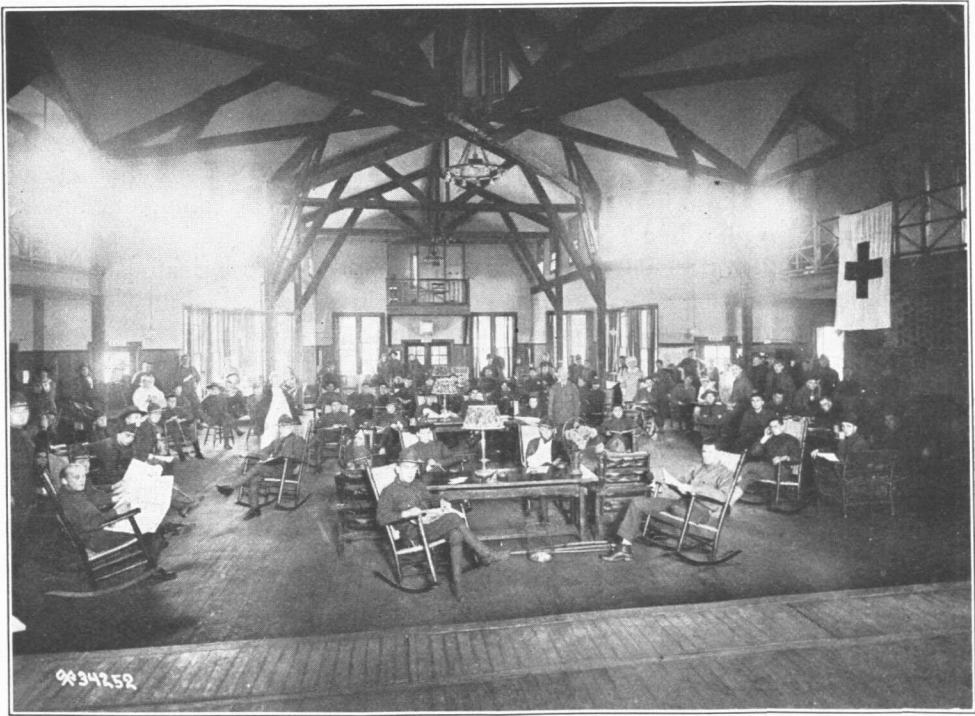


FIG. 82.—Interior of an American Red Cross convalescent house

instances all of the hospital communication work to the American Red Cross representatives.¹³ Other commanding officers followed this lead during the summer and autumn of 1918. The epidemic of influenza which swept the country in September, October, and November, 1918, enormously increased the work of notifying relatives of sick and wounded men concerning their illness and of reporting their progress from day to day.¹³

CONVALESCENTS' SERVICE

For a time soldiers on the road to recovery had no place in which to spend their idle time, except wards and corridors of the hospitals; so, with the approval of the War Department, the American Red Cross, on June 30, 1918, had completed or had under construction 52 convalescent houses, in which con-

valescents might find recreation and amusement to facilitate their recovery.¹³ These buildings were intended primarily for the use of convalescent patients, but were available for such other services as the officer in command of the hospital may have desired. They provided writing and reading facilities, games, and entertainments. The American Library Association installed collections of books, periodicals, and papers. Each building contained a platform which could be used either as a solarium or as a stage. It also contained a number of bedrooms for the use of relatives of men dangerously ill. A small kitchen was provided for the preparation of food for visitors and American Red Cross personnel.

RECREATION IN HOSPITALS

The division of recreation in hospitals was organized to provide, in cooperation with the educational service of the Surgeon General's Office, supplemental recreation for the sick and wounded in hospitals.¹³

It became apparent, after the armistice was signed, that the real load of the reconstruction work in military hospitals in the United States would soon arrive, and it was evidently necessary to divide the field of activity among the welfare organizations in order to avoid confusion and overlapping of efforts.¹¹ When a tentative plan had been drawn up to meet the recreational activities of the Medical Department educational service and the American Red Cross combined, a conference of all welfare organizations was called on November 25, 1918, by the American Red Cross. To this conference were invited representatives of the American Red Cross, the Commission on Training Camp Activities, the United States Naval Commission, the Young Men's Christian Association, the Jewish Welfare Board, and the National Catholic War Council. This conference had for its primary purpose the definite establishment of the status of welfare agencies other than the American Red Cross, with special reference to their cooperation with the American Red Cross in their work in military hospitals. The following program drawn up by representatives of the educational service of the Surgeon General's Office and the American Red Cross was presented and was approved by the conference:¹³

1. Entertainment and recreation in convalescent houses:

(a) To maintain, through the American Library Association, a library of technical works, approved fiction, current magazines, periodicals, and newspapers ("home town" papers when practicable), and to make them available to the patients. To make known to the patients the existence of the library and encourage its use by them by use of posters, circulars, etc.

(b) To organize, encourage, and conduct reading circles, debates, story-telling hours, etc.

(c) To provide training in amateur theatricals.

(d) To provide leadership for the development of bands and orchestras, arrange enlistment for training of the men, place and hours of individual and group practice, supply instruments and music, and to cooperate with the hospital authorities in the use of such bands and orchestras as may be organized.

(e) To provide leadership for the development of singing, individually and in groups such as trios, quartettes, etc., and of community singing.

(f) To furnish and maintain a supply of writing materials and tables or desks at which letter writing may be done and to encourage correspondence.

(g) To furnish and maintain an equipment of indoor games, such as cards, checkers, chess, dominoes, crokinole, etc.

(h) To furnish and maintain musical equipment of player-piano, phonograph, and rolls and records therefor.

(i) To furnish stereoscopes and a supply of photographs chosen with particular reference to their educational value for use therewith.

(j) To present at regular intervals entertainments of motion pictures, professional talent concerts, musicals, etc.

(k) To organize and supervise social functions such as dances, receptions, etc., for patients.

(l) To supply fruit and flowers, smoking materials and approved refreshments in convalescent houses and to supervise "winter evening" recreations such as popping corn, roasting apples and marshmallows, etc., at fireplaces.

2. Entertainment and recreation in wards:

(a) To furnish "home newspapers" to patients when practicable and, in any event, the best available daily newspapers; to arrange that items of general current interest be read, and to distribute books, magazines, and reading matter.

(b) To regularly distribute a supply of writing materials, post cards, etc., and encourage the writing of letters.

(c) To furnish and maintain such games as may be suitable, such as checkers, cards picture puzzles, etc.

(d) To furnish and maintain an equipment of phonographs and an assortment of, records, the latter to be circulated from ward to ward in such manner as will insure frequent change and variety of selections.

(e) To furnish stereoscopes and an assortment of photographs chosen with particular reference to educational value, the latter to be circulated from ward to ward so as to insure frequent change in assortment available in a particular ward.

(f) To present at regular intervals entertainments of motion pictures, professional talent, musicians, singers, etc.

(g) To supply fruit, flowers, smoking materials, etc.

3. Entertainment and recreation out of doors:

(a) To provide tools, seeds, etc., for the planting of flower gardens, window boxes of plants, vines or trellis, etc., about convalescent houses.

(b) The arrangement and supervision of auto rides, matinées at theaters, and the transportation involved in such activities.

4. Entertainment and recreation for able-bodied personnel:

(a) To provide ample reading and writing facilities.

(b) To furnish and maintain an equipment of indoor games such as cards, checkers, dominoes, etc.

(c) To provide leadership and instruction in individual, group, and community singing.

(d) To provide instruction in and encourage the development of amateur theatricals, debates, lecturing, etc.

(e) To provide instruction in and encourage the development of musical activities, mandolin and guitar clubs, etc.

(f) To present at regular intervals entertainments of motion pictures, professional talent, lectures, concerts, etc.

(g) To provide for and supervise such social functions as dances, receptions, etc.

(h) To arrange for participation in exercises and games such as tennis, basket ball, handball, croquet, etc.

5. Supplemental services:

To arrange for personal religious services and ministrations in wards at the request of individual patients.

Under the above program the American Red Cross devoted its energies more particularly to recreation for patients in convalescent houses and wards, while the services of the allied welfare organizations were to be utilized chiefly in connection with recreation and entertainment furnished for the able-bodied personnel to the extent and at the intervals requested by the American Red

Cross. The American Red Cross was to be the primarily responsible organization for all volunteer activities in the hospitals.

There were in all about 47 reconstruction hospitals, and at each of these an American Red Cross recreational officer was appointed, with such assistants as he needed, for the purpose of coordinating the recreation work of all the welfare agencies within the hospital and for working out and developing the program of recreation in conjunction with the chief of the educational service at the hospital.¹³ Even before the program was fully developed in the reconstruction hospitals practically every military hospital desired that the program be extended to them.¹³ The superintendent of nurses, Surgeon General's Office, also desired that this recreational program be extended to include all nurses in all military hospitals, and the chief of educational service, in turn, requested that this program be likewise extended to all educational and physiotherapy aides in the reconstruction hospitals.¹³ The program was accordingly extended to all military hospitals and to the nurses and the aides.

In November, 1919, the War Department took over all the work of the allied welfare organizations except that of the American Red Cross.¹⁴

In Army hospitals investigations of a medical social nature were undertaken, including those looking toward the provision of proper aftercare of patients at home.¹³ The entire service had been a heavy obligation and responsibility for the American Red Cross, but results had more than justified every effort.¹³

An evidence of the increasing opportunity for this class of service was found in the work inaugurated December 10, 1919, in connection with patients suffering from mental disturbances as the result of their war experience.¹³ The problem of these men had always been a serious one and in many instances even pitiful. It was realized from the beginning that the closest possible system of follow-up would have to be employed to insure that each patient had proper care and personal attention. The department of military relief and the department of civilian relief cooperated to the end that all reports concerning men discharged from hospitals on surgeon's certificates of disability should go forward at once to the home-service section in whose jurisdiction the man resided.

It soon became evident that a special report of transfer of mental patients was highly desirable.¹³ The department of civilian relief, through arrangements with the Bureau of War Risk Insurance, had been receiving notice of authorization of transfers in order that it might notify the division officers and home-service sections concerned, but it was found that this method was not practicable because many of the transfers authorized were never made and information about those which were made not infrequently failed to reach national headquarters of the American Red Cross until some time after the patient had actually been removed.¹³ It was realized that the American Red Cross field representatives at the hospitals had excellent opportunities for obtaining this information in advance from the personnel records of the hospital. Accordingly, a form of daily report of mental cases was drawn up and sent out on December 10, 1919, in order that from that date forward there would be no missing link in the chain of service which would tie the man fast to the sources of care and assistance on which he had such an enduring claim.

RED CROSS INSTITUTE FOR THE BLIND

As related in Chapter VI, the responsibility for the continued functioning of General Hospital No. 7, after the Medical Department of the Army gave over its control, was assumed by the American Red Cross.¹⁵ Under this arrangement, though the Medical Department held the property on lease, it turned over to the American Red Cross on May 25, 1919, all buildings on a revocable license, so that that organization, in cooperation with the Federal Board for Vocational Training, could carry on the instruction of the blind. The place now became the Red Cross Institute for the Blind.¹⁵

The purpose of the institute was to help the men blinded in the war to become equipped again as quickly as possible to meet their share of the social, civic, and economic requirements of their respective communities.¹⁵

At the beginning four major courses of instruction were offered in the institute, consisting of the supplemental or preparatory course, the vocational course, the avocational course, and the recreational course.¹⁵ Among the supplemental courses of instruction were included Braille, English, typewriting and hand training, all essential regardless of what vocation a blinded man might decide to follow. It was the purpose of the institute to train every man so that he might use a typewriter efficiently, write intelligent business letters, and have a sufficient knowledge of Braille to enable him to keep his own notes and to read Braille literature satisfactorily.¹⁵

Through its volunteer workers the institute was able to provide sufficient teachers so that each man might have an individual teacher in such work as Braille; the use of the typewriter; in the training of the hands, as in weaving of nets and baskets, and in simple cabinet making and carpentry; also in training the hearing, as in piano tuning, to furnish an important asset to one who could not see.¹⁶

The vocational training aimed to prepare the man for his life work. Courses were given in three general lines—agriculture, commercial, and industrial. Intensive investigations and surveys were made in each of these fields to determine what operations in each of them could successfully be performed by blinded men. Through these studies there was obtained much valuable information and the field of opportunity for the blinded man actually was widened. The widest possible latitude was given, so that a man might obtain almost any kind of training desired, provided that it appeared to be practicable and advisable for him. Special courses were developed to fit individual needs and desires whenever it was possible to do so; ¹⁵ for example, the president of a large insurance company was engaged for several weeks giving intensive instruction in the various forms of insurance.¹⁷ After it had been demonstrated that vulcanizing was practicable work for the blind a course in that subject was started. As a result a score of men received this instruction.¹⁷

An interesting feature of the work along this line was the establishment of the Evergreen Victory Stores.¹⁷ The first was opened at the institute in September, 1919, and a second at Perryville, Md., in November following. Both were under the direct management of the institute and were used as training stations for men taking commercial work. Subsequently a number of stores were established by blinded men who finished the store courses.¹⁷

The avocational courses were important. The blind man, unable to use his spare time in the same way as the man with sight, is confronted with the problem of what to do on holidays, week ends, and evenings. Idleness is a detriment to the blind man; to be busy is a tonic, and to have diversion is essential; therefore, all men in the institute were urged to take some avocational as well as vocational training. Among the many lines of avocational training that were available and suitable were life insurance, bookbinding, basket making, and music.¹⁵

For such times as the blind man did not wish to be occupied at either his vocation or avocation the institute encouraged him to take work along purely recreational lines.¹⁵ To a large number music seemed to offer the maximum of relaxation. The men also found much diversion in social gatherings, and the two weekly dances at the institute were very popular with them. Swimming and other athletic diversions, such as bowling, likewise had their followers. For those who enjoyed participation in public affairs and in club or lodge life there were provided student organizations which encouraged practice in public speaking and participation in some parliamentary procedure.¹⁵

AMERICAN LIBRARY ASSOCIATION

Welfare organizations other than the American Red Cross were delegated to activities primarily for the benefit of the troops rather than the patients;¹⁸ however, they could participate in hospital activities through the American Red Cross. The American Library Association functioned in this way.

This association, organized in 1876, was designated by the War Department in July, 1917, as the agency to provide a free library service for the Army for the period of the war.¹⁹ In developing this service the American Library Association was able to derive a trained personnel from the members of the library profession throughout the country.

One of the important contributions of the American Library Association to the welfare of the Army during the World War was the provision of free library service for the patients, nurses, official staff, and corps men in hospitals.¹⁹

In the Army hospitals in the United States this work assumed the proportions of an extensively organized service.¹⁹ During the period of the World War books and magazines were supplied to a total of approximately 150 Army hospitals. In each of them provision was made for expert administration or supervision on the part of trained librarians. In 66 hospitals, those containing approximately 500-bed patients or more, the American Library Association maintained its own administrative personnel. A trained librarian, usually a woman, was in charge of the library. To extend the library service throughout the hospital, she had the help of a staff of assistants, sometimes trained librarians supplied by the American Library Association and sometimes members of the enlisted personnel of the hospital detailed by the commanding officer to the library. In hospitals where no personnel was maintained by the American Library Association a trained librarian gave expert supervision, visiting the hospital library at frequent intervals to give advice and assistance to the person in charge of the library, who was usually detailed from the hospital personnel or a member of the personnel of some other welfare organization already

established in the hospital. In many of the smaller hospitals the American Red Cross gave support to the work of the American Library Association by assuming the actual administration of the service within the hospital.¹⁹

HOSPITAL LIBRARY

The aim of the hospital library, while including within its scope service to all branches of the personnel, was to secure for the patients especially the highest degree of service from books, journals, and newspapers.¹⁹ The main collection of books usually was located in some central place, sometimes in quarters provided within the Red Cross house or sometimes in a room or building provided especially for the purpose by the military authorities. The supply of books was



FIG. 83.—Hospital library, American Library Association

liberal, amounting to 10,000 volumes or more in some of the largest hospitals, with a range broad enough to supply a real catholicity of taste and a wide diversity of needs. Fiction, which was provided in generous quantities, comprised chiefly the sort which aims wholly to divert. In its selection for this purpose the American Library Association was guided mainly by the expressed preferences of the patients in so far as their tastes were found to be wholesome.¹⁹

SUPPORT OF THE EDUCATIONAL WORK

It was in the support of the educational work in the reconstruction hospitals that the American Library Association endeavored to make its service most vital.¹⁹ It was held to be the function of the association to provide for the man injured in war or disabled by its hardships and consequently incapacitated for

his former civilian pursuits the help which vocational and technical books can render. Every technical book for which a patient demonstrated a real need was supplied for him. The hospital librarian endeavored also to render every assistance to the work of the educational department. Reference books were provided for the instructors of the various classes and the help of near-by public libraries was utilized in research work.

SUPPLY OF BOOKS

Subscriptions for general and technical magazines were provided for each hospital, and the supply was largely augmented by gifts of used copies from residents in near-by towns and by the magazines available through the special 1-cent mailing provision of the Post Office Department.¹⁹ From time to time the librarians gave publicity to the need for magazines to keep the flow up to the required volume.

HOME NEWSPAPERS

One of the most popular features of the work and one which was not without some therapeutic value was the distribution of home-town papers among the patients.¹⁹ The American Library Association supplied all hospitals with a selected list of newspapers from various localities, and in many cases the librarian was able to extend the list through the cooperation of local agencies, which made home-town papers available in large quantities.

BRANCH LIBRARIES AND WARD SERVICE

In addition to the central library, which provided well-stocked bookshelves, magazine tables, and newspaper racks, with a library assistant always in charge, branch libraries were established in important centers in some hospitals.¹⁹ For patients confined to bed and consequently unable to visit either the main library or any of its branches definite provision was made. In several cases their needs were met by installing smaller collections of books and magazines in the various wards and on the ward porches where they would be accessible to the men through ward masters and nurses. In the great majority of hospitals, however, a more satisfactory service was given through the use of a special bedside book truck. With this book truck, well loaded with books, magazines, and newspapers, the librarian or his assistant would go through the wards, making it possible for each man to choose his own reading matter and to secure expert advice or assistance in selection. Figure 84 is a representation of this ward service.

In many cases special collections were installed in the nurses' quarters and in the quarters of the medical staff, and every effort was made to provide for the hospital men a service as satisfactory as that given the patients.

SERVICE TRANSFERRED TO THE WAR DEPARTMENT

This library service to military hospitals in the United States reached its maximum in the spring of 1919, when the number of patients was greatest.¹⁹ As the number of men in a hospital was reduced, personnel was sometimes withdrawn, but every hospital received an adequate service as long as it continued in operation. The service continued under the direction of the American

Library Association until November 1, 1919, when, at the suggestion of the American Library Association, it was transferred to the control of the War Department, together with the library service in camps and posts.¹⁹ Included in the transfer were all books and full equipment. The trained library personnel, was also taken over by the Army, under whose direction the service was continued.

YOUNG MEN'S CHRISTIAN ASSOCIATION

The Young Men's Christian Association, which conducted extensive work in all of the Army camps at the beginning of the war, erected huts in the hospital areas.²⁰ The program which was carried on was available not only to the

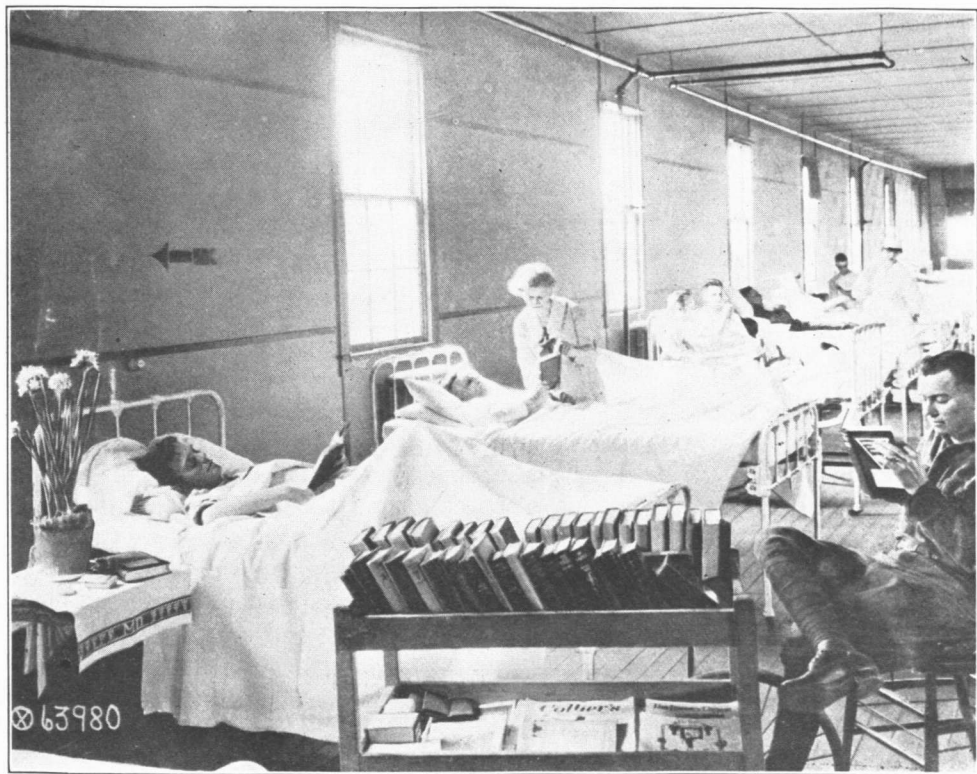


FIG. 84.—Ward library service, American Library Association

patients but also to the enlisted personnel and employees of hospitals units. While the patients were able to enjoy the entertainments, movies, and religious services, many of them naturally were spectators rather than participants in the athletic activities. During convalescence many of them were able to take part in the educational work.

When the overseas sick and wounded began to return to this country, a reconstruction program was put on at the request of the medical officers through the physical department of the Young Men's Christian Association.²⁰ Corrective exercises were given and such games taught as would be beneficial in bringing back health. Men in the hospitals were reached through a regular hospital

organization which included bedside visitation, movies, and entertainments in the wards. For those who were able to move about a social and religious program was promoted in the buildings of this association.

The reconstruction work was begun through cooperation with the military hospital authorities and special equipment was made available in certain camps.²⁰ Through trained physical directors and the use of graded exercises, men were helped to overcome the effects of abnormal conditions resulting from injuries. It was found that cheerfulness, energy, and a comradeship spirit were valuable adjuncts in the adaptation of games and apparatus exercises to the needs of individual patients. Interesting results were accomplished in the experiment of special exercises used for limbering affected muscles and joints and the prevention of atrophy, the education of muscles of arms and legs to the use of artificial limbs, and in the use of general games of a competitive nature as a mental stimulant in nervous disorders. Effective results were also obtained in the grouping and grading of men for exercises and games during the convalescent period.

In accordance with the general policy of the Young Men's Christian Association, all work of this sort ceased when the volume of need grew to the point where the Government itself was justified in making official provision for it.²⁰

YOUNG WOMEN'S CHRISTIAN ASSOCIATION

The "hostess houses" conducted by the Young Women's Christian Association²¹ exercised a direct bearing on the morale of patients, for they provided accommodations over short periods for their female relatives during visits. As all hotels in the neighborhood of large camps and hospitals were continually overcrowded and often were at an inconvenient distance, the hostess house always allowed a greater portion of the visitor's time to be spent with the patient, and in many instances was the deciding factor which allowed the visit to be made. These houses also provided an attractive and homelike center for the men themselves, where they could enjoy various forms of entertainment, meet female friends, and buy a wholesome meal.

JEWISH WELFARE BOARD

The Jewish Welfare Board, after it began functioning as a welfare agency,²¹ included in its program extensive hospital activity.²² Daily visits to the wards constituted part of the routine of each field representative of the Jewish Welfare Board.

In this work the volunteer hospital committees of the community branches of the Jewish Welfare Board were of great assistance. Operating without interference with hospital regulations and in complete cooperation with the military authorities, the men and women of the cities and towns neighboring the hospitals brought to the bedside of the sick soldier the comfort of contact with people who reminded him of his own folks back home.

Throughout, it was the aim of the Jewish Welfare Board to serve all the men, irrespective of religious creed or denomination, and in addition to make adequate provision for special needs of the soldiers of Jewish faith.²² The program included every type of service requisite to meeting the physical, spiritual, and mental needs of the sick and wounded men.

HOSPITAL SERVICE DIVISION

When wounded and convalescent men began returning in large numbers from overseas the special problems relating to their welfare resulted in an elaboration of the Jewish Welfare Board's program.²² A hospital service division was organized in January, 1919, to promote special activities in conjunction with the efforts of the hospital authorities, educational recreation officers of the hospitals, and the American Red Cross.²²

The Jewish Welfare Board, recognizing the importance of physical reconstruction and vocational reeducation in the treatment of overseas patients, assigned representatives of this board to hospital work, men of mature judgment, pleasing personality, tact, sympathy with Jewish ideals and aims, and initiative.²² In addition they possessed special training that fitted them for aiding in the educational and recreational program. Altogether, 54 field representatives were assigned to 40 general hospitals, 17 base hospitals functioning in physical reconstruction, 17 regular base hospitals, 17 debarkation hospitals, and 6 miscellaneous hospitals. In a large number of instances the workers covered two or more hospitals that were in close proximity.

RECREATION CENTERS

While in most instances the representatives utilized existing facilities for the conduct of their activities in the hospitals, the Jewish Welfare Board realized its obligation to contribute its share to the recreational facilities by erecting buildings in hospital grounds and, wherever this was impractical, by establishing recreation centers in the vicinity of the hospital.²² At Fort McHenry, Md., a recreation building was erected; at Walter Reed General Hospital, Washington, and at General Hospital No. 43, Hampton, Va., centers were established just outside the hospital grounds; in all other instances recreational quarters were secured in the towns adjacent to the hospital.²²

These centers and buildings became the gathering places for convalescents and corps men in their hours of leisure; here they received articles of comfort, cigarettes, fruit, writing materials, newspapers, magazines, and books. In these quarters they sought and received advice from the field representative on various personal problems and were inspired to greater contentment and to a more rapid recovery.

WARD SERVICE

The representative of the Jewish Welfare Board made ward visitation one of his chief duties; every reasonable and needful service was extended and every effort was made to induce in the individual a state of mind that would facilitate and hasten his recovery.²²

Special ward entertainments were arranged for the men confined to bed. Motion pictures, vaudeville shows and concerts, followed by the distribution of refreshments, were part of the ward program. In this work the volunteer hospital committees visited the wards, bringing a message of cheer and service characterized by a matronly solicitude for the welfare of the wounded men. In addition to the usual distribution of articles of comfort they made purchases of things specially requested by the men.

SERVICE SUPPORTING RECONSTRUCTION

An important task of the field representative was to encourage and induce the patient to avail himself of the opportunities for reeducation and vocational training offered by the hospital authorities.²² The workers of the Jewish Welfare Board in daily contact with the men, with whom they established personal and friendly relations, impressed upon them the importance of reeducation and the necessity of training for readjustment to normal civilian life.

As a further aid in this work the Jewish Welfare Board distributed thousands of copies of *My Diary* to the patients in the hospitals.²² This booklet, attractively arranged, contained information regarding war-risk insurance, the Smith-Sears Act, photographs and descriptions of educational activities in which wounded men might participate, blank pages for diary purposes, and other material, the purpose of all of which was to stimulate interest on the part of the patient in his own speedy recovery and to assist the hospital authorities in their efforts at rehabilitation and reeducation.

The Jewish Welfare Board assisted the education department in numerous other ways, the chief of which was supplying needed equipment.²² Typewriting machines, bicycles, roller skates, tools of various kinds, farm machinery, reed, desks, printing outfits, and special educational materials were furnished.

ENTERTAINMENT FOR HOSPITAL PERSONNEL AND PATIENTS

From the viewpoint of the special problems relating to the care of wounded and sick soldiers an adequate and varied entertainment program in the hospital was of importance.²² Vaudeville and motion-picture shows, amateur nights, concerts, musicales, socials, picnics, minstrel shows, banquets, dramatics, and dances were arranged regularly for both convalescents and corps men. In addition, wounded men were given automobile and bus rides, taken on sight-seeing tours, sleigh rides, launch parties, and boat rides. Theater parties frequently were arranged in the neighboring towns. Baseball, bowling, basketball and football teams composed of wounded and slightly disabled men were formed and games arranged. The Jewish Welfare Board likewise was successful in promoting athletic competition among disabled men. In addition, checker and chess tournaments were arranged in the hospitals. A checker and chess expert was engaged to tour some of the hospitals and give instruction in these games.

Every secular and Jewish holiday was fittingly celebrated, generally including some form of special entertainment.²² One of the features of the entertainment program was the distribution of refreshments and cigarettes among the soldiers present.

It was the effort of this board to provide diversion and recreation for every man, and every resource was utilized in this regard in order that the Jewish Welfare Board might in some degree help in maintaining the morale of the men and in keeping them mentally absorbed in such activities as would distract them from all thought of their ailments.²²

In response to a special need and in accordance with the wishes of the War Department, the Jewish Welfare Board undertook welfare work at the hospitals and camps in behalf of non-Jewish Russians and men of other Slavic

rac^{es}.²² A large number of these men did not understand the English language and had but little conception of American institutions and Government and the principles for which this country was engaged in the war. The fact that these men, confined to the hospitals, were, in addition, lonely, dejected, and ill at ease in their unaccustomed surroundings made more important the necessity for a generous program of welfare work.

Men specially qualified by reason of their understanding of the psychology and language of the Russians were assigned to this work.²² Lectures in their native tongue were delivered to gatherings of these men, special pamphlet material supplied, foreign newspapers, magazines, and books furnished, and entertainments provided. Cigarettes, fruit, and other much desired comforts were distributed among them, and every need met by the field worker. Personal welfare work, involving many special problems relating to these men of Slavic extraction, constituted an important element of the program.

IN CONVALESCENT CENTERS

In response to a request from the War Department Commission on Training Camp Activities, the Jewish Welfare Board inaugurated a welfare program in the convalescent centers established in some of the large Army camps.²² In addition to the usual program described herein the field representatives actively participated in the Government organization and direction of activities. In some instances workers were placed in charge of educational and recreational activities. Special entertainments, home hospitality, and classes were arranged for the men in these centers. Refreshments, cigarettes, and souvenirs were liberally distributed among the convalescent men.

REFERENCES

- (1) Act of April 24, 1912, 37 Statutes, 90.
- (2) Special Regulations, No. 61, War Department, October 8, 1917; General Orders, No. 17, War Department, February 13, 1918.
- (3) General Orders, No. 82, War Department, July 5, 1917.
- (4) Memorandum from Maj. Henry R. Hayes, S. C., N. A., for Major Brackett, January 2, 1918. Subject: Medical Aides. On file, Historical Division, S. G. O.
- (5) Letter from W. Frank Persons, director general civilian relief, American Red Cross, Washington, to Mr. Otis H. Cutler, manager insular and foreign division, Red Cross Building, Washington, D. C., October 30, 1917. On file, Record Room, S. G. O., 080-1 (American Red Cross), T.
- (6) Annual report of the American National Red Cross for the year ended June 30, 1918. On file, Historical Division, S. G. O.
- (7) Letter from W. Frank Persons, director general of civilian relief, the American Red Cross National Headquarters, Washington, D. C., to Maj. Gen. William C. Gorgas, Surgeon General United States Army, Washington, D. C., December 27, 1917. On file, Record Room, S. G. O., 353.91-1 (General).
- (8) Memorandum from the Surgeon General to the Secretary of War, November 7, 1917, and attached papers. On file, Record Room, S. G. O., 356 (Reconstruction).
- (9) General Orders, No. 17, War Department, February 13, 1918, par. V.
- (10) Office memorandum, the Surgeon General's Office, May 4, 1918. On file, Record Room, S. G. O., Miscellaneous Letters, A-577

- (11) Final report of physical reconstruction as conducted by the Surgeon General, United States Army, 1917 to 1919, by Maj. A. G. Crane, S. C., U. S. Army, director of the educational service, division of physical reconstruction, Surgeon General's Office, undated, 316. On file, Historical Division, S. G. O.
- (12) Instructions for reconstruction aides, Overseas Service, Office of the Surgeon General, undated. On file, Record Room, S. G. O., Miscellaneous Letters, C-428.
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- (15) Annual report, the American National Red Cross, for the year ending June 30, 1919.
- (16) The American Red Cross Assistance to the United States Medical Department in the United States, by Lieut. Col. C. H. Connor, M. C. On file, Historical Division, S. G. O.
- (17) Annual report, the American National Red Cross, for the year ending June 30, 1920.
- (18) General Orders, No. 57, War Department, May 9, 1917; Bulletin No. 50, War Department, September 5, 1917; General Orders No. 46, War Department, May 9, 1918.
- (19) Letter from M. W. Meyer, in charge of publicity, American Library Association, Washington, D. C., to Col. Casey A. Wood, M. R. C., U. S. A., Office of the Surgeon General, Washington, D. C., November 18, 1919 (and attached papers). On file, Historical Division, S. G. O.
- (20) Letter from J. S. Tichnor, associate general secretary, the national council of the Young Men's Christian Association of the United States of America, to Lieut. Col. F. W. Weed, Washington, D. C., May 2, 1925 (and attached paper). On file, Historical Division, S. G. O.
- (21) History of the Commission on Training Camp Activities, April, 1917, to September, 1919, prepared by the war plans division, General Staff. Copy on file, Historical Division, S. G. O.
- (22) Letter from Louis Kraft, supervisor home service department, Jewish Welfare Board, New York City, to Col. Casey A. Wood, M. R. C., C. S., secretary board of publications, Office of the Surgeon General, War Department, Washington, D. C., January 23, 1920 (and attached papers). On file, Historical Division, S. G. O.

SECTION VI

NONMILITARY GOVERNMENTAL DEPARTMENTS CONCERNED WITH CONTINUING THE REHABILITATION OF DISABLED SOLDIERS

The history of reconstruction as carried out by the Medical Department of the Army would be incomplete without some account of the continuation of the program after the disabled soldiers were released from military control, even though the functions of the Federal Board for Vocational Education, the Bureau of War Risk Insurance, and Veterans' Bureau (formerly the Bureau of War Risk Insurance) were entirely outside the jurisdiction of the Army and contacted with Army reconstruction at only a few points.

BUREAU OF WAR RISK INSURANCE

This bureau was first established in 1914 under the Treasury Department to insure vessels against the hazards of war.¹ Its functions were extended in June, 1917, to include the insurance of certain maritime personnel,² and in October, 1917, were so radically extended that the insurance of the lives and physical ability of soldiers and sailors became its main function.³ Provision was also made for courses of rehabilitation, reeducation, and vocational training for those who became permanently disabled through injuries, but the act did not specify whether such courses were to be provided through an existing Government agency, by civil institutions, or otherwise.³ No records are discoverable which show that such courses were ever given by this bureau, the Federal Board for Vocational Education eventually assuming the function. The provision for these courses was repealed in June, 1918.⁴

By an amendment in December, 1919, the bureau was authorized to furnish to soldiers and sailors disabled by injuries "reasonable governmental medical, surgical, and hospital service and such supplies, including wheel chairs, artificial limbs, trusses and similar appliances as may be useful and reasonably necessary."⁵ It was very desirable that the temporary artificial limbs to be supplied by the Army to amputation cases should conform in general action to the permanent limb which would be furnished later by the Bureau of War Risk Insurance. The Army, therefore, supplied provisional artificial limbs fulfilling these requirements, made of fiber, and thus enabled the disabled soldier to acquire a limb when it was needed and to have the use of it during the interim prior to his discharge.⁶

The United States Public Health Service was given charge of the medical aspect of the work of the Bureau of War Risk Insurance, and this subject will therefore be covered under that service, although this section of the work remained under the nominal jurisdiction of the Bureau of War Risk Insurance.

UNITED STATES PUBLIC HEALTH SERVICE

ACTIVITIES SUBORDINATE TO THE BUREAU OF WAR RISK INSURANCE

The medical officer in charge of the medical division of the Bureau of War Risk Insurance was originally a civilian, but regulations governing the bureau which were issued in May, 1918, required that an officer of the United States Public Health Service hold that position.⁷ Congressional action in March, 1919, assigned all the medical activities of the Bureau of War Risk Insurance to the United States Public Health Service, including authority to buy, lease, or transfer to that service hospitals, hospital sites, hospital service, and hospital equipment for the purpose of treating beneficiaries of the Bureau of War Risk Insurance and those classes of individuals which had theretofore been entitled to treatment by the United States Public Health Service.⁸

COOPERATION WITH THE ARMY

Cooperative relationships were informally established between the Bureau of War Risk Insurance and various divisions in the Surgeon General's Office in the effort to correlate reconstruction before and after discharge from the Army.⁹ The first definite Army instructions to this end were issued in December, 1918,¹⁰ and provided that an officer should be assigned, wherever disabled soldiers were being treated, held, or discharged, to handle all matters relating to the work of the Bureau of War Risk Insurance and of the Federal Board for Vocational Education. It also authorized representatives of these two organizations to enter all hospitals, posts, camps, and stations for the purpose of interviewing disabled men who had been recommended for discharge, and to examine their records.

ORGANIZATION

In the spring of 1918 the medical division of the Bureau of War Risk Insurance consisted of three sections—medical and surgical relief, compensation, and medical inspection.⁷ An expansion was necessary with the demobilization of the military forces and reorganization into the following sections was made in April, 1919: General and military surgery; general medicine; tuberculosis; eye, ear, nose, throat, and dental; neuropsychiatric; miscellaneous.⁷ The addition of the following sections was made by June, 1919: Prosthetics; statistical; medical accounts; dental; complaint.⁷

FUNCTIONS

The functions of the medical division are summarized as follows:⁷

1. To determine the nature, extent, and probable duration of the disabilities of claimants, and to render opinions relative thereto to the compensation and insurance claims division as a basis for awards of compensation or insurance. Opinions as to disabilities of claimants are formed by (a) reviewing the medical evidence on file in the case, and if that is insufficient, by (b) securing a record from the Army or Navy of the claimant's medical record while in the service, and by (c) securing additional physical examinations of claimants by medical officers of the United States (usually United States Public Health Service officers) or by physicians designated by the director.

2. To adopt and apply a schedule of ratings and reductions in earning capacity from specific injuries or combination of injuries of a permanent nature, based, as far as practicable, upon the average impairments of earning capacity resulting from such injuries in civil occupation, and from time to time to readjust the schedule or ratings according to actual experience.

3. To see that claimants of the Bureau of War Risk Insurance are furnished with such reasonable governmental surgical, medical, and hospital service and with appliances as the director may determine to be useful and reasonably necessary.

4. To issue certificates of injury, after medical examinations have been made, to the effect that the injured person at the time of discharge or resignation was suffering from an injury likely to result in death or disability.

5. To secure a physical examination and to render an opinion as to the physical condition of applicants for reinstatement of insurance that has lapsed.

6. To review and render an opinion as to the medical evidence of death.

7. To maintain an active, sympathetic, and harmonious liaison with the several divisions of the Bureau of War Risk Insurance and with correlated intra- and extra-governmental agencies.

EXPECTED CASES REQUIRING TREATMENT

A survey of the probable number of men who would require treatment by the Bureau of War Risk Insurance resulted as follows:⁷

It was carefully estimated from all available sources of data that the maximum number of men and women discharged with some disability would approximate 640,000. It was not presumed that this entire group would prove compensable, or would even make claim, since many of the disabilities would be of a minor nature; furthermore, more than 100,000 men were accepted into the service with certain disabilities already existing and noted (Group C men).

Included in this large estimated number of potential claimants were certain groups or classes of diseases and injuries which could definitely be stated to be compensable, and, in the main, permanently so. Such classes were (a) nervous and mental disorders; (b) tuberculosis; (c) major amputations; (d) certain injuries and conditions of the special senses. There was also the uncertain though undoubtedly large problem of the thousands of cases of circulatory diseases, digestive diseases, respiratory diseases other than tuberculosis, and conditions and diseases of the bones and joints and of organs of locomotion.

There were 1,700 beneficiaries of the Bureau of War Risk Insurance under treatment at the beginning of the year 1919, but by the end of the year 24,500 men had been discharged from the military services because of tuberculosis and 50,000 on account of nervous and mental disorders.¹¹ To meet the requirements of the expected flood of patients it was considered that approximately 12,000 hospital beds would have to be available at all times and that eventually 30,000 beds would be necessary.⁷ All Army hospitals were opened for the admission of beneficiaries of the Bureau of War Risk Insurance in February, 1919,¹² and congressional action of March, 1919, provided the means for furnishing the remainder of the required beds—transfers of Army cantonment hospitals to the United States Public Health Service and the utilization of beds in civil hospitals supplying those required for immediate use.¹¹

HOSPITALS IN OPERATION, 1919

The United States Public Health Service was operating 20 marine hospitals, a tuberculosis sanatorium at Fort Stanton, N. Mex., and the following United States Public Health Service hospitals on June 30, 1919:¹³ Palo Alto, Calif. (formerly United States Army Base Hospital, Camp Fremont), capacity 1,000; Greenville, S. C. (formerly United States Army Base Hospital, Camp Sevier), capacity 1,235; Alexandria, La. (formerly United States Army Base Hospital, Camp Beauregard), capacity 1,000; Dansville, N. Y. (formerly United States Army General Hospital No. 13), capacity 250; Norfolk, Va. (Sewells Point) (United States Army Quartermaster Terminal), capacity 213; Chicago, Ill. (formerly United States Army General Hospital No. 32), capacity 550; Corpus Christi, Tex. (formerly United States Army General Hospital No. 15), capacity 235; Washington, D. C., leased, capacity 80; Jacksonville, Fla. (formerly United States Army Base Hospital, Camp Joseph E. Johnston), capacity 830; East Norfolk, Mass. (formerly United States Army General Hospital No. 34), capacity 300.

REORGANIZATION

Decentralization became necessary with the increase in the work, and the country was divided into 14 districts, with a district supervisor from the United States Public Health Service in charge of each.⁷ This officer had a dual responsibility to the Director of the Bureau of War Risk Insurance and to the Surgeon General of the United States Public Health Service. Civilian physicians throughout the districts were appointed as "designated examiners."⁷

IMPROVED CARE OF INSANE

Closer cooperation was found to be necessary in the handling of insane cases in the spring of 1919 in order that there would be no interval between the time of discharge from the Army and the commencement of continued care in an institution near the patient's home.¹⁴ To this end, instructions were issued that the discharge of an insane patient would be accomplished only after his arrival at the civil institution designated by the chief medical advisor, Bureau of War Risk Insurance.¹⁴

RECONSTRUCTION SECTION ESTABLISHED

The reconstruction section of the United States Public Health Service was organized in July, 1919, to establish, supervise, and direct the work of the several branches of physiotherapy and occupational therapy, including amusements and recreations.¹⁵ The American Red Cross and other auxiliary agencies lent their assistance, as they had in Army hospitals. The actual work of reconstruction was started in the various hospitals in September, 1919, and had been extended to 42 stations by the end of that fiscal year, with 102 reconstruction aides on duty in hospitals.¹⁵ The total reconstruction personnel at the end of the year was 299, and the demand for personnel to carry on the work of physiotherapy and occupational therapy always exceeded the available supply.

A conference between representatives of the Surgeons General of the United States Public Health Service and of the Army was held in July, 1919, to arrange for the transfer to the United States Public Health Service of such supplies and occupational personnel as the Army no longer required.¹⁶

SECTION OF NEUROPSYCHIATRY

The duties of the section of neuropsychiatry related to the development of temporary and permanent special-service hospitals, the establishment of special wards in general hospitals, the development of out-patient treatment and care, examinations, and reports, the use of contract hospitals and their inspections and the development of a nursing and special-service corps in connection with the care and treatment of that class.¹⁵ On June 30, 1920, the United States Public Health Service had 230 beds for epileptics, 367 for psychoneurotics, and 1,415 for insane cases; 4,128 nervous and mental cases had been treated in United States Public Health Service hospitals and 5,641 in contract institutions.

SECTION OF TUBERCULOSIS

The tuberculosis section had 4,274 beds on June 30, 1920, and was proposing to admit tuberculous cases to all general hospitals.¹⁵ A morale officer was detailed to each institution in turn to assist in instructing patients in matters requiring their cooperation in treatment.

NURSING CORPS

The nursing corps on June 30, 1920, consisted of approximately 1,100.¹⁵ Difficulty in recruiting a sufficient number of nurses was experienced, especially those trained to care for neuropsychiatric cases.

FEDERAL BOARD FOR VOCATIONAL EDUCATION

For many years prior to the World War the Federal Government had allotted various amounts of money to be used by the individual States for vocational educational purposes, but largely without control.¹⁷ Systematic cooperation and control on the part of the Federal Government was first introduced by the Smith-Hughes Act, approved February 23, 1917, which created the Federal Board for Vocational Education, to consist of the Secretaries of Agriculture, Commerce, and Labor, the United States Commissioner of Education, and three citizens of the United States to be appointed by the President, one of the latter to be a representative of manufacturing and commercial interests, one a representative of agriculture, and a third a representative of labor.¹⁸

The members of the board were formerly appointed July 17, 1917, by the President. The board held conferences with State representatives for the formulation of plans of action, a great deal of their attention being directed toward efforts that would be of assistance to the military forces in the war.¹⁷ These efforts assumed in October, 1917, the form of vocational training of drafted men for specialists' positions prior to reporting at the cantonments. Another activity was the study of rehabilitation for disabled soldiers and sailors, and the Federal Board for Vocational Education participated in many conferences on the subject with various governmental departments which were interested.¹⁷

Thousands of disabled men returned to civil life with scant or no knowledge of the rehabilitation law, due to two main reasons:¹⁷ (1) The lack of facilities for rehabilitation in the early months of the war and the desire of the military authorities to avoid suggestions which would cause discontent among men

who had been rehabilitated and retained in the service; (2) the impossibility at times of providing the personnel necessary, owing to the great number of discharge points, and the fact that many men denied a disability in order to insure their early discharge.

The feature of the law which made the Federal Board for Vocational Education the educational agents in the training, and the Bureau of War Risk Insurance responsible for the payment of men while in training and for the selection of cases to be trained, was responsible for a great deal of the above-mentioned ignorance of the law.¹⁷ This situation was corrected by the passage of an amendment to the rehabilitation act in June, 1919, which placed the entire responsibility for selection, training, and payment with the Federal Board for Vocational Education.²¹

EDUCATIONAL POLICIES

The Federal Board for Vocational Education utilized existing institutions in training its students in preference to operating schools of its own.¹⁷ The patronage strengthened the schools, and assistance here and there in the matter of educational equipment enabled them to furnish the necessary amount and variety of training facilities.

In the early development of the work men were placed in educational institutions rather than in training on the job, for these principal reasons:¹⁷ Such institutions could expand with sufficient rapidity to meet the requirements; in the days of greatest pressure it was much easier to place men in educational institutions than to find suitable places in job training; placement training for the first year was practically impossible because of the wage situation. The small wage which many employers gave, in addition to the job training, led to interminable difficulties with the Bureau of War Risk Insurance in regard to the reduction in compensation. After the amendment of July 11, 1918, the board decided that it would be advisable to disregard any wage paid to a student in training.¹⁷

The blind, the deaf, the tuberculous, and the mental cases were trained along the same general lines as those employed in the Army hospitals, the blind receiving courses in the Red Cross Institute for the Blind, Baltimore, Md.

The function of the Federal Board for Vocational Education was determined to be the governing of rehabilitation rather than the actual teaching, this latter function being delegated to civil educational institutions, commercial schools, shops, factories, etc.¹⁷ Labor associations, employers, and educational institutions cooperated in the training and placement in a substantial way.¹⁷

Patients in hospitals of the United States Public Health Service were an exception to the above rule.¹⁷ There the Federal Bureau for Vocational Education undertook the educational, occupational, and vocational training,¹⁵ the United States Public Health Service then furnishing the professional care as it had for beneficiaries of the Bureau of War Risk Insurance.¹⁷ There were about 250 training courses offered and the same number of placement trainings.¹⁷

A CONVALESCENT FARM HOSPITAL

An interesting experiment in rehabilitation was Convalescent Hospital No. 1, Lawrenceville, N. J.¹⁷ Originally established by the Army with the idea of furnishing a place where convalescence and practical instruction in farming would be coincident, it was found that the number of men who desired to take such a course was too small to justify the maintenance expense. The Federal Board for Vocational Education therefore took over the 500-acre farm and buildings April 1, 1919, and conducted it as a receiving station and school of practical farming until August 5, 1919, just prior to the time when the land-grant colleges were ready to admit the students of the Federal Board for Vocational Education.¹⁷

The instruction was organized on the short-course, shop, laboratory, and field plan. The unit courses given were as follows:

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| <p>1. Agriculture, horticulture, and dairying:</p> <ul style="list-style-type: none"> Care of plants in greenhouse. Care of horses and hogs. <p>Dairying:</p> <ul style="list-style-type: none"> Feed. Milk. Breeds and breeding. Calves. Judging. Diseases. <p>Farm crops.</p> <p>General agriculture.</p> <p>Trucking:</p> <ul style="list-style-type: none"> Truck crops. Plant enemies. Harvest. Soil. Production of crops. Marketing. | <p>2. Farm mechanics—Continued.</p> <ul style="list-style-type: none"> Farm implements. Farm tractors. Repair of farm machinery. Farm-lighting system. <p>3. Poultry:</p> <ul style="list-style-type: none"> Breeds. Brooding. Care of poultry. Marketing. Incubator. Housing. Diseases. <p>4. Academic:</p> <ul style="list-style-type: none"> English. Arithmetic for mechanics. Arithmetic. Reading. Americanization. Letter writing. Arithmetic for truckmen. Geography. Spelling. |
| <p>2. Farm mechanics:</p> <ul style="list-style-type: none"> Farm carpentry. Gas-engine operation. Farm management. Automobile repair. | |

While the total enrollment was less than 200, this farm-hospital school would undoubtedly have been an efficient agency in caring for the convalescent farm-minded men had the war continued longer. It returned men to the farm better fitted for farm activities and bridged the gap between hospital discharge and the opening of established educational institutions.²²

UNITED STATES VETERANS' BUREAU

The medical care and rehabilitation of soldiers and sailors of the World War were originally accessory functions of the Bureau of War Risk Insurance, the United States Public Health Service, and the Federal Board for Vocational Education, but had become the predominant activities of the latter two organizations by the year 1919.²³ The resultant great expansions of the divisions handling the veteran relief work overshadowed the parent organizations and

were cumbersome and unwieldy.²³ A plan for decentralization and consolidation in districts of all the activities concerned was completed in February, 1921, but the contemplated action was prevented by the discovery that such action would not be legal.²³ To prepare for anticipated amendatory legislation, 50 medical officers from the districts were called to duty in Washington and nearly all pending claims requiring medical action were completed by July 22, 1921.²³

The functions of these three organizations which were concerned in the compensation, medical care, and vocational education of veterans were invested in a new organization August 9, 1921, when Public Act No. 47, Sixty-seventh Congress, established the United States Veterans' Bureau. Decentralization was effected in order to expedite the work, and 14 district and 126 subdistrict offices were established within a few months.²³ The authority to award insurance claims, compensation insurance, and vocational training was retained in the central office. These conferences led to a general conference in January, 1918,^a when a tentative bill was drawn up which later became the vocational rehabilitation act of June 27, 1918.¹⁹

REHABILITATION RESPONSIBILITY

This act transferred all rehabilitation duties for disabled soldiers and sailors, after discharge from the military or naval service, from the Bureau of War Risk Insurance to the Federal Board for Vocational Education. The latter had apparently expected, before the passage of the act, that the reconstruction program would be committed to its care, for it sent 15 individuals to Canada for training in that line of work in order to secure a trained nucleus for its inauguration.¹⁷ Arrangements were made, very shortly after the passage of the act referred to above, to utilize the existing facilities of the country in the training of disabled men along professional, agricultural, industrial, and trade lines, to secure the cooperation of various agencies in their proper care and placement, and to secure the welfare of their families while they were in training.¹⁷

ARMY COOPERATION

Application was made to the Surgeon General of the Army late in June, 1918, for permission to send representatives of the Federal Board for Vocational Education into Army hospitals to explain to disabled men the benefits of the new law.¹⁷ This permission was not given until after the armistice began, on the grounds that the rehabilitated men would be needed in the Army for limited service and should not be brought into contact with civilians seeking their ultimate restoration to industrial life.¹⁷ Three representatives were sent to France, however, in August, 1918, and brought the benefits to the attention of nearly all patients in the overseas hospitals, largely through the assistance of the American Red Cross and with the approval of the chief surgeon, American Expeditionary Forces.²⁰

^a See Chapter I.

REFERENCES

- (1) Act September 2, 1914 (38 Statutes 711).
- (2) Act June 12, 1917 (40 Statutes 102).
- (3) Act October 6, 1917 (40 Statutes 398).
- (4) Act June 27, 1918 (40 Statutes 617).
- (5) Act December 24, 1919 (41 Statutes 371).
- (6) Osgood, R. B.: A survey of the orthopedic services in the United States Army hospitals, general, base, and debarkation. *Journal of Orthopedic Surgery*, Boston, 1919, i, 359.
- (7) Medico-military activities during the World War to July, 1920, by Treasury Department, Bureau of War Risk Insurance. On file, Historical Division, S. G. O.
- (8) Act March 3, 1919 (40 Statutes 1302).
- (9) Letter from division of military orthopedic surgery to the Acting Surgeon General United States Army, October 4, 1918, and attached documents. Subject: Weekly report. On file, Historical Division, S. G. O.
- (10) Circular No. 132, War Department, December 11, 1918. Subject: Cooperation with the War Risk Insurance Bureau and Federal Board for Vocational Education.
- (11) Public Health Reports, xxxiv, No. 23, June 6, 1919.
- (12) Circular Letter No. 98, Surgeon General's Office, February 20, 1919.
- (13) Treasury annual reports, 1919, United States Public Health Service, 220.
- (14) Circular No. 225, War Department, April 30, 1919.
- (15) Treasury annual reports, 1920, United States Public Health Service, 252, 260.
- (16) Letter from the Surgeon General, United States Public Health Service, to the Surgeon General, United States Army, War Department, Washington, D. C., July 17, 1919, and attached papers. On file, Record Room, S. G. O., 353.91-1.
- (17) Annual reports, Federal Board for Vocational Training, 1917, 1918, 1920.
- (18) Act February 23, 1917 (39 Statutes 929).
- (19) Act June 27, 1918 (40 Statutes 617).
- (20) Letter from chief surgeon, American Expeditionary Forces, to Lieut. Col. F. T. Murphy, M. C., director medical and surgical department, Army Red Cross, Hotel Regina, Paris, October 18, 1918, and attached documents. Subject: Proposed work in France of the Federal Board for Vocational Education. On file, Record Room, S. G. O., 704.6.
- (21) Act July 11, 1919 (41 Statutes 158).
- (22) Final report of physical reconstruction, by Maj. A. G. Crane, S. C., 328.
- (23) Annual reports of the director, United States Veterans' Bureau, for the fiscal years ending June 30, 1922, and June 30, 1923.

SECTION VII

SCOPE OF RECONSTRUCTION; ITS BEARING ON ACHIEVEMENT

It is impossible to evaluate medical or educational service in figures. Benefits oftenest of the highest grade, most lasting, and of vital value to the patients are of such intangible nature as to defy quantitative measurement. The best that can be done here will be to give the number of men reached by the service, and in a few cases, where quantitative measurements were possible, show the individual benefits received. As regards the individual cases, additional references are made to them in chapters dealing with reconstruction as conducted in hospitals.

NUMBER OF MEN REGISTERED

Table 6 gives in detail the new registrants in educational service by months, during the period July, 1918, to December, 1919, in each of the hospitals for which formal reports were made to the Surgeon General. The actual number of men reached by educational service in all hospitals is larger than the 110,638 shown in the table.¹ Some men were enrolled in this service before July, 1918; some hospitals failed to report; others maintained some reconstruction service though not officially designated reconstruction centers. On the other hand, though effort was made to exclude duplication, it is probable that some errors have been made, which is only natural in view of the large number of men dealt with, and the widely scattered location of the reconstruction hospitals.

TABLE 6.—*Numbers of new individuals enrolled in the educational service, by months, from July, 1918, to December, 1919*¹

Month	Number	Month	Number	Month	Number
1918		1919		1919	
July.....	88	January.....	5,471	July.....	7,568
August.....	1,481	February.....	11,053	August.....	6,086
September.....	2,596	March.....	14,053	September.....	4,950
October.....	2,301	April.....	14,884	October.....	4,219
November.....	3,244	May.....	13,066	November.....	3,225
December.....	3,854	June.....	9,682	December.....	2,817
Total.....	13,564	Total.....	68,209	Total.....	28,865

Grand total..... 110,638

Table 7 shows the population in United States Army hospitals functioning in physical reconstruction and men in the educational service, by months, for the year 1919. In addition, this table shows the average per cent of hospital population enrolled. Thus, it may be seen that the hospital population enrolled in educational work steadily rose from 29 per cent in January, 1919, to 48 per cent in May, and to 61 per cent in November, or an average of 44 per cent of

patients enrolled during 1919. At first sight, though the steady increase is encouraging as showing increased efficiency in organization and popularity of the educational service, yet it is at all times surprisingly low. Investigation, however, reveals the fact that of the patients in hospital a large number never were at any time in condition to be benefited by or to engage in educational activities. During the earlier months of 1919, and especially in the spring, large numbers of patients who had been transferred as such from the American Expeditionary Forces were immediately ready for discharge upon their arrival at the hospitals in the United States. Unless a man was likely to be in hospital for more than seven days it was not wise to enroll him as an educational student. The percentage of this class of men was relatively large, especially in the base hospitals, since they automatically gravitated thereto because of their lack of serious disability. Acute medical and surgical cases were ineligible, as a rule. Another class of men ineligible to educational service comprised patients in contagious disease wards, though in some rare instances the service was carried into these wards.¹

TABLE 7.—*Population in United States Army hospitals functioning in physical reconstruction; men in educational service, by months, 1919*¹

	Popu- lation	Men in educa- tional service	Per cent of popula- tion in educa- tional service		Popu- lation	Men in educa- tional service	Per cent of popula- tion in educa- tional service
January	28, 023	8, 167	29	July	37, 546	20, 578	55
February	63, 428	16, 296	26	August	30, 258	15, 944	53
March	74, 946	24, 969	33	September	24, 737	14, 224	58
April	66, 640	28, 500	43	October	24, 112	14, 072	58
May	62, 964	30, 096	48	November	22, 305	13, 598	61
June	55, 554	26, 339	47	December	19, 616	11, 895	61

Furloughs were granted very liberally to overseas patients upon their arrival in the United States, approximating 14 per cent of a hospital's population during the first half of 1919, varying, of course, from month to month and in different hospitals and depending somewhat upon the character of disability.¹ The rule was to offer furloughs initially to men returning from overseas. Officer patients, as a class, were not well represented in the educational service because of the lack of classes in the higher subjects.¹

Various studies by different hospitals at different times indicated that the number of men eligible to educational services varied greatly. The assumption is warranted that, for the entire year of 1919, 35 per cent of the patients were ineligible. If the monthly percentages of men enrolled be recalculated upon the estimate of 65 per cent of population, representing the eligibles, it appears that 67.7 per cent of men eligible to the service were reached throughout the months of January to December, 1919, inclusive. In many hospitals the percentage exceeded 90 during what might be termed favorable months—that is, after the spring of 1919.¹

Chart IV shows the number of individual subject enrollments. The data upon which this chart is based are given in Table 8.

TABLE 8.—Enrollments in Army hospital schools, by months, from August, 1918, to December 1919¹

Month	Number	Month	Number	Month	Number
1918		1919		1919	
August.....	3,234	January.....	18,172	July.....	40,175
September.....	5,217	February.....	29,733	August.....	31,675
October.....	6,289	March.....	44,917	September.....	28,773
November.....	7,867	April.....	52,739	October.....	27,543
December.....	12,757	May.....	56,850	November.....	23,453
		June.....	49,798	December.....	20,821
Total to June 30, 1919.....					287,573
Total to Aug. 31, 1919.....					359,423
Total to Dec. 31, 1919.....					460,013

It is evident that the men were enrolled in more than one subject each—that is to say there is an average of three subjects for each man. The months

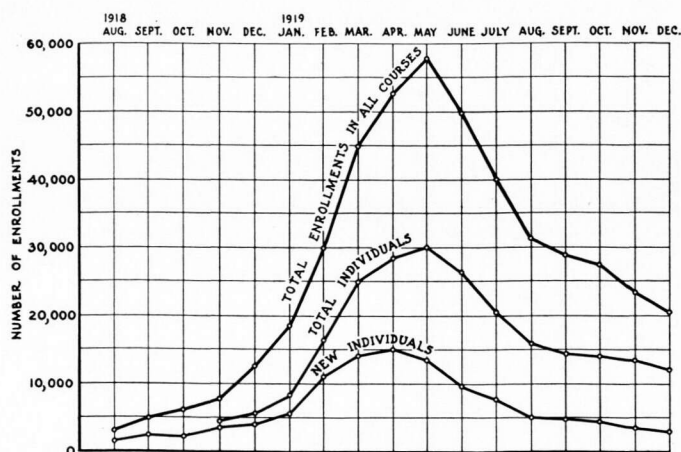


CHART IV.—Enrollments in the educational service in reconstruction hospitals, by months, August, 1918, to December, 1919

from January to December, 1919, when the organization could reasonably be expected to be in full operation, showed each man registered in 1.9 courses.

PERIOD AVAILABLE FOR WORK

The length of time during which patients will be in hospital and available for reconstruction courses will always be of vital importance in planning for work of this type, particularly as regards the educational activities. It will be of less importance in considering the proposed activities of the physiotherapy department and of the curative workshops, as the completion of these activities usually indicates the completion of treatment and determines the time of the patient's discharge from hospital. On the other hand, the occupational and educational activities begin as soon after admission as practicable and may continue to the time of discharge. A knowledge of the prospective period of hospitalization for the various types of disabilities is therefore essential in planning educational courses. Chart V furnishes limited information on this subject,

and emphasizes the wisdom of preparing short courses which are more or less complete in themselves, as exemplified by the unit courses of study previously mentioned. The studies on which this chart is based cover two periods—one during the winter months of 1918-19, before any great number of overseas cases had been received, and the other during the spring of 1919, when many such cases were in the hospitals in this country. Over one-third of all men enrolling for educational work during the first period remained in hospital for not over 10 days, and it must be remembered that only about 65 per cent of the patients in a hospital are eligible, for one reason or another. The chart, therefore, furnishes a working basis on which to construct plans for an educational service, with data applicable to both the training and combat periods.

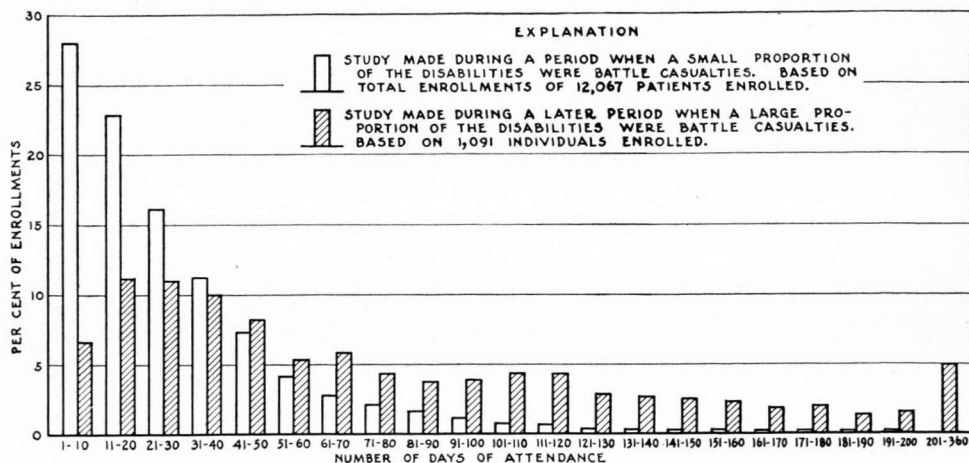


CHART V.—Days spent in hospital schools, and percentage by day groups, of 13,158 patients enrolled in the educational service

TYPES OF CASES

The results which could be attained, in so far as reconstruction is concerned, depended largely on two factors concerning the students—their physical and their mental conditions.

PHYSICAL CONDITION

The types of cases most frequently dealt with are illustrated by Table 9. It may be observed that of the 12 classes of disease and injury included therein 6 are of such a general character as to include many entities, and that, even so, a single pathologic process—pulmonary tuberculosis—occupies second place in frequency of occurrence.

TABLE 9.—*Types of cases registered for educational work*¹

	1918	1919				Total
	Decem- ber	Janu- ary	Febru- ary	March	April	
Orthopedic.....	1,098	1,758	3,962	5,016	5,228	17,062
Pulmonary tuberculosis.....	1,610	1,907	1,004	3,139	2,376	10,036
Disease and wounds.....	323	665	2,338	1,689	1,757	6,772
Convalescent.....	315	239	1,044	1,610	2,167	5,375
Other general medical.....	467	419	760	1,326	1,413	4,385
Other general surgical.....	212	445	732	1,567	1,296	4,252
Amputations.....	496	644	865	1,125	1,040	4,170
Injury to nervous system.....	308	384	481	837	1,191	3,201
Functional neuroses.....	283	169	435	730	773	2,390
Eye, ear, nose, and throat.....	306	318	336	536	671	2,167
Cardiovascular.....	635	227	340	313	336	1,851
Insanity.....	112	142	165	636	289	1,344
Grand total.....						63,005

MENTAL CAPACITY

If it is considered that the patients in reconstruction hospitals were representatives of the general body of men secured by the draft, then the psychological ratings applicable to the latter must indicate the mental capacity of the prospective students of the educational service. The average mental age of white officers was about 18 years. Table 10 gives the data for enlisted men.

TABLE 10.—*Approximate mental ages of recruits, World War Army*^a

Mental age, years	White	Negro	Mental age, years	White	Negro
	<i>Per cent</i>	<i>Per cent</i>		<i>Per cent</i>	<i>Per cent</i>
19.....	2	-----	9.....	5	16
18.....	2	-----	8.....	3	15
17.....	4	-----	7.....	2	9
16.....	6	1	6.....	-----	5
15.....	9	2	5.....	-----	2
14.....	14	3	Less than 5.....	-----	1
13.....	16	5			
12.....	17	10	Median mental age.....	13.1	10.1
11.....	12	15			
10.....	8	16	Number of cases.....	94,004	18,891

^a Source of information: Annual report of the Surgeon General, United States Army, 1919, Vol. II, 1075.

The results of a study of the mental capacity of 1,020 patients are shown in Table 11. Those of this group who were attending the school rated somewhat higher in the grades A and B of the classifications than those who were not attending school.

TABLE 11.—*Intelligence grades of 1,020 patients, United States Army General Hospital No. 29, Fort Snelling, Minn.*

Grade	In school		Not in school	
	Number	Per cent	Number	Per cent
A.....	54	9.7	27	5.8
B.....	57	10.3	44	9.5
C.....	388	69.9	348	74.8
D.....	45	8.1	37	8.0
E.....	11	2.0	9	1.9
Total.....	555	-----	465	-----

The choice of an educational activity depended not only upon the man's mental capacity but also upon his previous education. The results of an analysis of the records of 12,067 reconstruction patients is given in Table 12. It is probable that in the majority of those in which no schooling was recorded there was none to record, which would raise the percentage of illiteracy to approximately that given for the entire country by the United States Census of 1910—7.7 per cent. In this connection it should be borne in mind that for all practicable purposes education which stops with the third grade leaves the person illiterate, if one considers that literacy should mean ability to comprehend readily simple written matter. However, men who had received a third-grade education in their youth and subsequently acquired studious habits should be thoroughly literate at the average age of the soldiers of our World War Army. It should be borne in mind also that men with higher educations could appreciate more readily the advantages to be derived from the educational courses, a higher percentage of them therefore enrolling and thus raising the educational standard of the enrolled group as compared with those who did not enroll. As may be seen from the table referred to, 65.6 per cent of the 12,000 men attended school not beyond the eighth grade, 21 per cent had a more or less complete high-school education, and 4 per cent had attended college for one year or more.

TABLE 12.—*Schooling of 12,067 patients enrolled in the educational service*¹

	Number	Per cent		Number	Per cent
No schooling.....	595	4.9	High school:		
Schooling not recorded.....	466	3.9	First year.....	855	7.1
Schooling not classified.....	675	5.6	Second year.....	679	5.6
Total.....	1,736	14.4	Third year.....	359	3.0
Elementary:			Fourth year.....	676	5.6
First grade.....	133	1.1	Total.....	2,569	21.3
Second grade.....	215	1.8	College:		
Third grade.....	388	3.2	First year.....	179	1.5
Fourth grade.....	705	5.9	Second year.....	158	1.3
Fifth grade.....	778	6.4	Third year.....	76	.6
Sixth grade.....	841	7.0	Fourth year.....	112	.9
Seventh grade.....	1,110	9.2	Total.....	525	4.3
Eighth grade.....	3,067	25.4			
Total.....	7,237	60.0			

A study of the vocations followed by the men prior to their entry into the Army is of interest in view of the fact that much of the work in question had a vocational bearing, both for the men who after discharge from the Army planned to continue training with the Federal Board for Vocational Education and for those who would return to active business. Table 13 gives the results of such a study in a group of 1,270 selected overseas men who were enrolled in the educational service.¹

TABLE 13.—Occupations of 1,270 returned overseas patients, United States Army General Hospital No. 28, Fort Sheridan, Ill.: Comparison of previous occupations with desired occupations¹

Occupation	Number				
	Previous	Satisfied to remain in—	Desiring change to—	Total desiring job in—	Desiring change from—
Actor.....	2	1	0	1	1
Advertising.....	3	1	0	1	2
Agriculture.....	335	247	35	282	88
Auto driver.....	26	11	7	18	15
Auto repairman.....	40	33	72	105	7
Baker.....	4	1	0	1	3
Bank clerk.....	3	2	0	2	1
Barber.....	9	8	1	9	1
Baseball player.....	1	0	1	1	1
Blacksmith.....	2	2	1	3	0
Boilermaker.....	5	3	0	3	2
Bookkeeper and accountant.....	8	7	13	20	1
Brakeman.....	10	4	3	7	6
Brass molder.....	2	1	0	1	1
Bricklayer.....	2	1	0	1	1
Building construction.....	6	2	2	4	4
Business for self.....	13	9	21	30	4
Butcher.....	6	4	0	4	2
Carpenter and cabinetmaker.....	23	14	1	15	9
Car repairer.....	1	1	12	2	0
Cheese maker.....	2	1	1	2	1
Cigar maker.....	2	1	0	1	1
Civil service (mail clerk).....	8	6	20	26	2
Commercial art.....	1	1	13	14	0
Cook.....	6	1	0	1	5
Chemist (industrial).....	3	1	1	2	2
Crane operator.....	2	2	0	2	0
Drafting (mechanical and architectural).....	6	3	6	9	3
Druggist.....	6	2	1	3	4
Electrician.....	23	20	35	55	3
Engineer (stationary and mechanical).....	17	8	8	16	9
Factory manager.....	3	2	0	2	1
Factory worker.....	21	9	3	12	12
Fireman.....	20	15	2	17	5
Fisherman.....	3	2	1	3	1
Flower broker.....	1	1	1	2	0
Forester.....	1	0	2	2	1
Gardener.....	3	1	0	1	2
Gas-engine mechanic.....	4	3	3	6	1
Horseshoer.....	4	0	0	0	4
Horse trainer.....	2	0	0	0	2
Inspector (factory).....	5	3	0	3	2
Insurance.....	4	2	3	5	2
Laborer.....	89	39	0	39	50
Lawyer.....	1	1	2	3	0
Lumberman.....	4	3	1	4	1
Machinist.....	81	47	8	55	33
Mason.....	3	2	0	2	1
Miner (coal).....	38	21	0	21	17
Musician.....	2	1	3	4	1
Moving-picture operator.....	2	2	1	3	0
Newspaper work.....	3	3	0	3	0
Nursing.....	3	2	0	2	1
Office clerk.....	72	33	30	63	39
Oxyacetylene welding.....	0	0	3	3	0
Painter.....	12	6	0	6	6
Paper maker.....	9	5	0	5	4
Pattern maker.....	3	1	0	1	2
Photographer.....	4	2	5	7	2
Plumber.....	4	2	0	2	2
Printer.....	16	14	1	15	2
Railroad work (surveying).....	3	3	1	4	4
Salesman and store clerk.....	43	32	15	47	11
Sawyer.....	1	0	1	1	1
Sheet-metal worker.....	10	5	0	5	5
Shoemaker.....	7	3	1	4	4
Soldier.....	9	1	2	3	8
Steam fitter.....	4	1	0	1	3
Stenographer.....	2	2	1	3	0
Street-car conductor.....	4	3	2	5	1
Structural-iron worker.....	3	3	4	7	0
Student.....	67	34	9	43	33
Tailor.....	8	3	2	5	5
Tannery.....	1	1	1	2	0
Teacher.....	12	5	2	7	7
Teamster.....	14	8	2	10	6
Telegrapher.....	4	3	7	10	1
Telephone (wireman).....	8	5	0	5	3
Ticket clerk (railroad).....	6	5	1	6	1
Upholstering.....	2	1	0	1	1
Vulcanizing.....	3	3	2	5	0
Waiter.....	4	0	0	0	4
Woodworker.....	5	2	0	2	3
Miscellaneous (one man concerned).....	53	18	9	27	35

CHOICE OF FUTURE VOCATION

The character of the disability also largely dictated the choice of a future vocation, more especially in certain classes of cases, as in tuberculosis. Among 860 cases of tuberculosis, 27.3 per cent gave farming as their choice.¹

SUMMARY OF WORK ACCOMPLISHED

A summary of the work accomplished is shown by Table 14, and a detailed statement of the enrollment in the various courses during the first six months of 1919 is shown in Table 15. As stated above, the actual number of men reached by the educational services in all hospitals was somewhat larger than the 110,638 accounted for in the table.

TABLE 14.—*Summary of enrollments in the educational service in reconstruction hospitals*¹

	1918					1919			
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.
Number of hospitals.....			16	17	25	27	41	44	45
Total patient population.....	5,041		12,048	12,794	23,455	28,023	65,022	73,319	66,640
Individuals enrolled in educational service.....				4,387	5,292	8,167	16,296	24,969	28,500
Percentage of registration enrolled.....				34	23	29	26	33	43
Subjects in which enrolled:									
Ward handicrafts.....				1,365	3,917	5,622	10,192	15,795	18,829
Ward academic.....				253	569	972	1,521	3,194	3,552
Shop work and trades.....				1,006	2,010	2,973	4,611	7,018	8,718
Agriculture.....				187	564	808	1,027	1,583	1,932
Commercial.....				294	1,117	2,013	3,276	4,713	5,055
General academic.....				2,472	2,439	3,168	5,845	7,045	7,620
Americanization.....			1,025	968	2,001	2,700	4,375	6,274	6,767
Recreational.....				872	1,633	2,616	3,261	5,569	7,033
Aggregate enrollment.....	3,234	5,217	6,289	7,867	12,757	18,172	29,733	44,917	52,739

	1919							
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Number of hospitals.....	42	38	23	17	16	15	14	13
Total patient population.....	62,964	55,554	37,546	30,258	24,737	24,112	22,305	19,616
Individuals enrolled in educational service.....	30,096	26,339	20,578	15,944	14,244	14,072	13,598	11,895
Percentage of registration enrolled.....	48	47	55	53	58	58	61	61
Subjects in which enrolled:								
Ward handicrafts.....	20,641	18,317	14,110	10,719	10,728	10,827	7,371	7,954
Ward academic.....	4,961	5,172	3,714	3,418	3,323	2,786	2,876	2,459
Shop work and trades.....	8,467	7,183	5,557	5,215	4,636	3,861	3,362	3,020
Agriculture.....	1,855	1,831	1,370	1,227	1,043	637	531	466
Commercial.....	4,721	3,885	2,883	2,332	2,108	1,946	1,572	1,310
General academic.....	8,056	6,502	5,269	4,490	3,962	3,947	3,425	2,802
Americanization.....	8,326							
Recreational.....	8,149	6,908	7,272	4,274	2,973	3,539	4,316	2,810
Aggregate enrollment.....	56,850	49,798	40,175	31,675	28,773	27,543	23,453	20,821

TABLE 15.—Detailed enrollment in educational service, January to June, 1919 ¹

Subject of instruction	January			February			March		
	Shop	Ward	Total	Shop	Ward	Total	Shop	Ward	Total
I. General (Academic):									
Reading.....	284	87	371	389	168	557	417	322	739
English.....	382	153	535	680	199	879	912	336	1,248
English for foreigners and beginners.....	358	-----	358	690	-----	690	1,002	-----	1,002
Spelling.....	294	53	347	426	85	511	479	223	702
Arithmetic.....	630	90	720	988	146	1,134	1,413	352	1,765
Rapid calculation.....	16	-----	16	101	-----	101	98	-----	98
Penmanship.....	575	132	707	1,021	173	1,194	1,430	208	1,638
Higher mathematics.....	121	9	130	222	18	240	263	68	331
Science.....	30	23	53	48	17	65	58	5	63
History.....	9	11	20	75	9	84	30	-----	30
Civil service.....	88	16	104	112	47	159	172	2	174
French.....	22	5	27	63	8	71	88	43	131
Geography.....	-----	-----	-----	7	-----	7	49	3	52
Music.....	-----	114	114	-----	-----	-----	-----	81	81
Braille reading.....	48	-----	48	36	-----	36	45	-----	45
Lip reading and speech correction.....	90	-----	90	63	-----	63	111	-----	111
Italian.....	-----	-----	-----	1	-----	1	-----	6	6
Latin.....	-----	-----	-----	6	18	24	-----	1	1
Spanish.....	57	4	61	101	-----	101	157	51	208
General.....	-----	-----	-----	-----	-----	-----	319	-----	319
Other courses.....	40	33	73	257	107	364	158	-----	158
Unclassified.....	-----	2	2	-----	3	3	-----	352	352
Total.....	3,044	732	3,776	5,285	999	6,284	7,201	2,053	9,254
II. A. Technical—Shops, Trades:									
Auto driving.....	18	-----	18	25	-----	25	67	-----	67
Auto repairs.....	462	-----	462	708	-----	708	1,166	-----	1,166
Auto mechanics.....	339	6	345	650	-----	650	1,149	-----	1,149
Blacksmithing.....	10	-----	10	7	-----	7	14	-----	14
Concrete working.....	10	-----	10	7	-----	7	5	-----	5
Electricity.....	183	-----	183	213	-----	213	414	-----	414
General mechanics.....	8	-----	8	5	-----	5	37	-----	37
Machinery.....	67	-----	67	98	-----	98	149	-----	149
Plumbing and pipe fitting.....	10	-----	10	1	-----	1	12	-----	12
Radio operating.....	18	-----	18	37	-----	37	50	-----	50
Radio electricity.....	2	-----	2	54	-----	54	46	-----	46
Telegraphy.....	258	4	262	317	6	323	448	23	471
Sheet-metal work.....	16	2	18	4	-----	4	12	-----	12
Vulcanizing.....	-----	-----	-----	8	-----	8	40	-----	40
Welding.....	37	-----	37	47	-----	47	65	-----	65
Painting.....	18	-----	18	14	-----	14	99	-----	99
Cartooning.....	15	-----	15	35	-----	35	41	-----	41
Shoe repairing.....	32	-----	32	51	-----	51	69	-----	69
Sign painting.....	60	-----	60	107	-----	107	145	-----	145
Tailoring.....	5	-----	5	5	-----	5	22	-----	22
Motion-picture operation.....	46	-----	46	30	-----	30	61	-----	61
Trunk making.....	-----	-----	-----	9	-----	9	4	-----	4
Applied arts.....	29	-----	29	-----	-----	-----	39	-----	39
Cable splicing.....	-----	-----	-----	21	-----	21	26	-----	26
Drafting.....	365	69	434	470	85	555	789	233	1,022
Printing.....	37	-----	37	44	-----	44	94	-----	94
Work with textiles.....	39	2,313	2,352	32	3,612	3,644	49	4,786	4,835
Carpentry (rough).....	137	-----	137	127	-----	127	221	-----	221
Woodworking.....	159	-----	159	245	-----	245	303	-----	303
Cabinetwork.....	-----	-----	-----	25	-----	25	115	-----	115
Bench woodworking.....	80	-----	80	380	-----	380	401	-----	401
Furniture repairing.....	17	-----	17	1	-----	1	3	-----	3
Woodworking (carving, etc.).....	58	841	899	1,808	1,808	142	2,439	2,581	2,581
Reed, cane, and fiber work.....	-----	797	797	32	1,555	1,587	73	2,596	2,669
Work in applied pattern.....	-----	145	145	-----	284	284	-----	282	282
Metal work.....	39	489	528	65	1,124	1,189	82	2,363	2,445
Leather, cardboard, and binding.....	13	374	387	22	651	673	28	1,233	1,261
Work in plastic materials.....	40	298	338	99	362	461	177	446	623
Miscellaneous.....	27	-----	27	81	652	733	361	1,650	2,011
Total.....	2,654	5,338	7,992	4,076	10,139	14,215	7,018	16,051	23,069
B. Commercial:									
Business courses.....	127	-----	127	248	-----	248	131	-----	131
Business correspondence.....	107	10	117	163	23	186	227	62	289
Bookkeeping and accounting.....	412	22	434	515	34	549	751	60	811
Commercial law.....	58	1	59	65	-----	65	93	2	95
Shorthand.....	199	28	227	359	66	425	552	190	742
Typewriting.....	847	78	925	1,441	169	1,610	2,484	440	2,924
Banking and insurance.....	12	-----	12	2	-----	2	38	-----	38
Salesmanship and advertising.....	79	4	83	167	4	171	213	16	229
Journalism.....	3	-----	3	10	-----	10	3	-----	3
Miscellaneous.....	11	-----	11	-----	-----	-----	221	-----	221
Total.....	1,855	143	1,998	2,970	296	3,266	4,713	770	5,483

TABLE 15.—Detailed enrollment in educational service, January to June, 1919¹—Continued

Subject of instruction	January			February			March			
	Shop	Ward	Total	Shop	Ward	Total	Shop	Ward	Total	
II. C. Agriculture—Farm:										
Poultry raising.....	36		36	46		46	83		83	
Animal husbandry.....	75		75	208		208	272		272	
Crop study.....	13		13	152		152	283		283	
Machinery.....				73		73	456		456	
Farm (general).....	468	5	473	316	8	324	151	48	199	
Dairying.....				11		11	2		2	
Miscellaneous—gardening.....	14		14	111		111	16		16	
Field.....	101		101					18	18	
Ward.....				93		93	59		59	
Greenhouse.....	101		101				243		243	
Total.....	808	5	813	1,010	8	1,018	1,565	66	1,631	
III. Recreational:										
Military drill.....	712		712	50		50	205		205	
Walks.....	238		238	226		226	600		600	
Physical training.....	669		669	1,279		1,279	1,991		1,991	
Hospital service.....	273		273	356		356	739		739	
Calisthenics.....	244		244	696		696	906		906	
Games.....	40		40	146		146	576		576	
Light therapeutics.....	336		336	164		164	355		355	
Special duty.....	104		104	106		106	66		66	
Dancing.....				30		30	131		131	
Total.....	2,616		2,616	3,053		3,053	5,569		5,569	
Grand total.....	10,977	6,218	17,195	16,394	11,442	27,836	26,066	18,940	45,006	
Subject of instruction	April			May			June			Total, January to June, 1919
	Shop	Ward	Total	Shop	Ward	Total	Shop	Ward	Total	
I. General (Academic):										
Reading.....	349	307	656	298	590	888	311	523	834	4,045
English.....	1,149	519	1,668	999	595	1,594	606	753	1,359	7,283
English for foreigners and beginners.....	971		971	1,233		1,233	1,094		1,094	5,348
Spelling.....	570	199	769	638	375	1,013	448	371	819	4,161
Arithmetic.....	1,436	402	1,838	1,535	738	2,273	1,187	765	1,952	9,682
Rapid calculation.....	75		75	116		116	65		65	471
Penmanship.....	1,586	275	1,861	1,636	361	1,997	1,341	509	1,850	9,247
Higher mathematics.....	325	88	413	344	106	450	248	97	345	1,909
Science.....	73	5	78	69	14	83	48	21	69	411
History.....	47	23	70	26	28	54	25	23	48	306
Civil service.....	133	24	157	126	31	157	103	30	133	884
French.....	66	90	156	105	105	210	90	116	206	801
Geography.....	76	7	83	77	2	79	91	4	95	316
Music.....		100	100				362	71	433	728
Braille reading.....	52	2	54	53		53				125
Lip reading and speech correction.....	133		133	140		140	95		95	504
Italian.....		1	1							8
Latin.....								3	3	29
Spanish.....	165	87	252	244	127	371	219	203	422	1,415
General.....	183		183	224	120	344	33		33	879
Other courses.....	426	95	521	386		386	231	227	458	1,960
Unclassified.....										357
Total.....	7,815	2,225	10,040	8,249	3,192	11,441	6,597	3,716	10,313	51,108
II. A. Technical—Shops, Trades:										
Auto driving.....	333		333	163		163	311		311	917
Auto repairs.....	581		581	680		680	478		478	4,075
Auto mechanics.....	1,975		1,975	2,238		2,238	1,918		1,918	8,275
Blacksmithing.....	7		7	7		7	14		14	59
Concrete working.....	11		11	12		12	14		14	59
Electricity.....	555		555	555		555	556		556	2,476
General mechanics.....	110		110	49		49	32		32	241
Machinery.....	229		229	311		311	254		254	1,108
Plumbing and pipe fitting.....	9		9	6		6	4		4	42
Radio operating.....	157		157	233		233	172	12	184	679
Radio electricity.....	10		10	15		15	32		32	159
Telegraphy.....	506	46	552	480	42	522	397	67	464	2,594
Sheet-metal work.....	11		11	39		39	82		82	166
Vulcanizing.....	104		104	87		87	86		86	325
Welding.....	79		79	109		109	103		103	440
Painting.....	48		48	20		20	23		23	222

TABLE 15.—Detailed enrollment in educational service, January to June, 1919¹—Continued

Subject of instruction	April			May			June			Total, January to June, 1919
	Shop	Ward	Total	Shop	Ward	Total	Shop	Ward	Total	
II. A. Technical—Shops, Trades—Continued.										
Cartooning.....	50		50	46		46	13		13	200
Shoe repairing.....	89		89	85		85	75		75	401
Sign painting.....	111		111	111		111	108		108	642
Tailoring.....	29		29	33		33	19		19	113
Motion-picture operation.....	198		198	106		106	62		62	503
Trunk making.....	1		1	5		5				19
Applied arts.....	96		96	112		112	189		189	465
Cable splicing.....	22		22							69
Drafting.....	809	224	1,033	834	177	1,011	676	101	777	4,832
Printing.....	126		126	103		103	64		64	468
Work with textiles.....	90	8,509	8,599	94	9,507	9,601	46	8,145	8,191	37,222
Carpentry (rough).....	199		199	196		196	121		121	1,001
Woodworking.....	343		343	262		262	241		241	1,553
Cabinetwork.....	109		109	85		85	65		65	399
Bench woodworking.....	404		404	415		415	299		299	1,979
Furniture repairing.....	3		3	6		6	5		5	35
Woodworking (carving, etc.).....	201	2,588	2,789	140	2,684	2,824	183	2,144	2,327	13,228
Reed, cane, and fiber work.....	83	3,831	3,914	71	4,169	4,240	6	4,185	4,191	17,398
Work in applied pattern.....		257	257		373	373		379	379	1,720
Metal work.....	130	498	628	96	992	1,088	184	626	810	6,688
Leather, cardboard, and binding.....	60	1,717	1,777	28	1,969	1,997	60	2,173	2,233	8,328
Work in plastic materials.....	173	1,346	1,519	146	331	477	109	411	520	3,998
Miscellaneous.....	571		571	489	616	1,105	182	259	441	4,888
Total.....	8,622	19,016	27,638	8,467	20,860	29,327	7,183	18,502	25,685	127,926
B. Commercial:										
Business courses.....	151		151	31		31	65		65	753
Business correspondence.....	349	33	382	267	46	313	226	76	302	1,589
Bookkeeping and accounting.....	833	81	914	724	97	821	567	89	656	4,185
Commercial law.....	140	6	146	126	15	141	101	25	126	632
Shorthand.....	546	158	704	525	178	703	435	132	567	3,368
Typewriting.....	2,565	648	3,213	2,629	923	3,552	2,131	820	2,951	15,175
Banking and insurance.....	30		30	22		22	101		101	205
Salesmanship and advertising.....	259	3	252	263	15	278	220	7	227	1,250
Journalism.....	17		17							33
Miscellaneous.....	165		165	134		134	39		39	570
Total.....	5,055	929	5,984	4,721	1,274	5,995	3,885	1,149	5,034	27,760
C. Agriculture—Farm:										
Poultry raising.....	175		175	79		79	77		77	496
Animal husbandry.....	240		240	217		217	262		262	1,274
Crop study.....	282		282	235		235	167		167	1,132
Machinery.....	120		120	176		176	173		173	998
Farm (general).....	736	97	833	631		631	652	92	744	3,204
Dairying.....	44		44	132		132	58		58	247
Beekeeping.....	9		9	4		4	41		41	54
Miscellaneous—gardening.....				25		25				25
Field.....	67		67	118		118	112		112	438
Ward.....	88		88		215	215	59		59	481
Greenhouse.....	93		93	147		147	28		28	420
General.....	78		78	38		38	202		202	662
Total.....	1,932	97	2,029	1,802	215	2,017	1,831	92	1,923	9,431
III. Recreational:										
Military drill.....	130		130	460		460	384		384	1,941
Walks.....	619		619	497		497	668		668	2,848
Physical training.....	2,129		2,129	2,063		2,063	2,368		2,368	10,529
Hospital service.....	298		298	342		342	552		552	2,560
Calisthenics.....	2,165		2,165	2,576		2,576	972		972	7,559
Games.....	733		733	1,164		1,164	1,229		1,229	3,888
Light therapeutics.....	577		577	809		809	228		228	2,469
Special duty.....	83		83				5		5	364
Dancing.....	183		183	113		113	288		288	745
Miscellaneous.....				95	37	132	214		214	346
Total.....	6,917		6,917	8,149	37	8,186	6,908		6,908	33,249
Grand total.....	30,341	22,267	52,608	31,388	25,578	56,966	26,404	23,459	49,863	249,474

A significant point is the concentration of the work during February, March, April, and May, 1919, due to the return of the majority of overseas men during those months. Fifty-three thousand and fifty-six men were enrolled during that time,¹ nearly one-half of the enrollment for the entire 18 months' period.

The period represented by Table 14 was less favorable for educational work than a later one, for the average of short stay in hospital was much higher. Nevertheless, the median case remained in hospital for 19.5 days, which is conclusive evidence of the possibility of doing really purposeful and valuable work, not only of a curative but also of an educational and vocational nature. Twenty days devoted seriously to a well organized, practical unit course of instruction will enable an intelligent man to accomplish much, and some of the unit courses were of not more than 10 days' duration. Thousands used this time to their advantage by learning to read and write, to train a new writing hand, to try their abilities in a new vocation; or used it materially to refresh and improve themselves in their previous civil occupation. Capable men can become trained as competent typists, assistant telegraphers, clerks, laboratory technicians, and mechanics' assistants in a period of time not in excess of the time spent by these men in educational activities in Army hospitals. If conservation is one of the duties of a republic, then a conservation of man-power by the utilization of otherwise wasted time in the improvement of the soldiers' qualifications should be a potent reason for maintaining some form of educational service, not only for its curative value but for its value in training men for army activities.

The so-called "Americanization" courses deserve special mention here. Reading, writing, arithmetic, English, penmanship, composition, history, and civics were included under this heading, and were in much greater demand than had been expected. Their popularity led to the development of "citizenship" courses for noncitizens of the United States, which consisted of instruction in the subjects necessary in order to qualify as a citizen, and the arrangement for the conference of citizenship to groups of the students. A study of the records of 12,874 men enrolled in the educational department showed that 1,729 of them were of foreign birth, and that 80 per cent of the 1,729 were enrolled in one or more subjects of the Americanization courses.¹

MENSURATION OF IMPROVEMENT, EDUCATIONAL SERVICE

As stated previously, the results accomplished by reconstruction work, as a general term applying to individuals, are rather difficult to evaluate; however, the progress made by individuals in the academic work can be determined with accuracy from a consideration of their daily records. On the other hand, it must be admitted that the estimation in some of the commercial and technical subjects is more difficult to so standardize as to be readily apparent.

Charts VI, VII, VIII, and IX were devised to give a curve for an average student by plotting from the average markings of classes over a prescribed course.² A study of the results attained by individuals would yield nothing different from those of ordinary civil schools for individuals of an equal mental equipment, except in so far as the physical handicaps of the soldier patients are concerned.

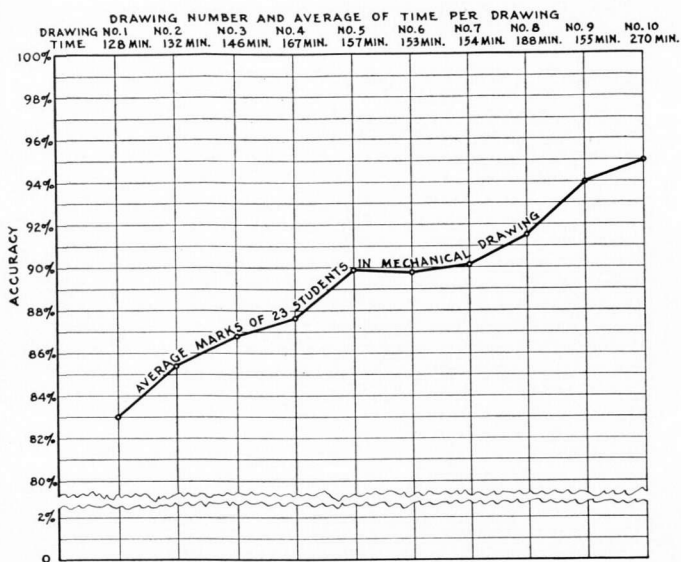


CHART VI.—Progress curve in mechanical drawing, average speed and accuracy, 23 students

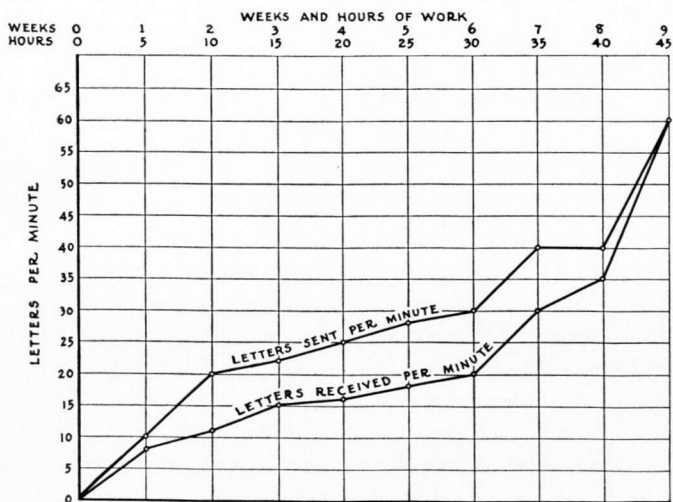


CHART VII.—Progress curve in telegraphy, average speed, 12 students

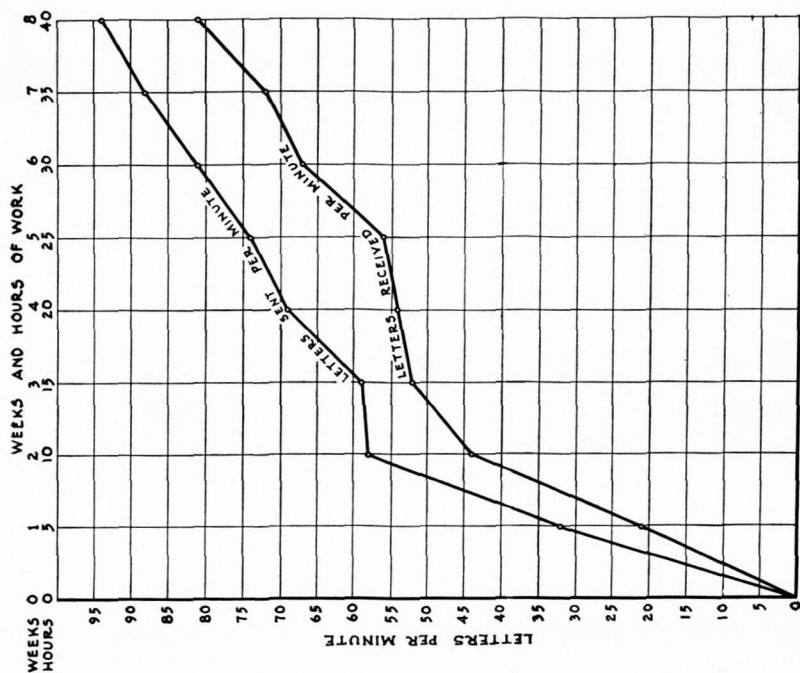


CHART IX.—Progress curve in typewriting, average speed and accuracy, 45 students

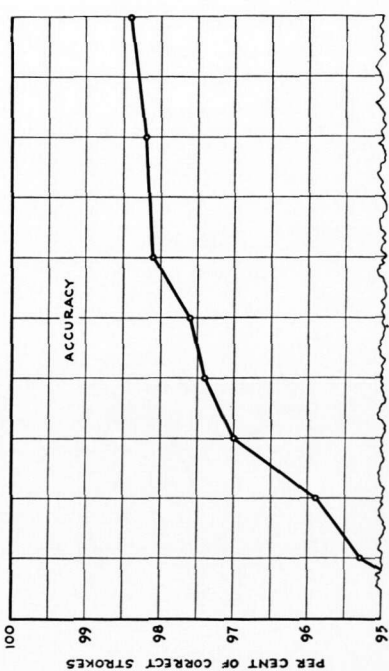
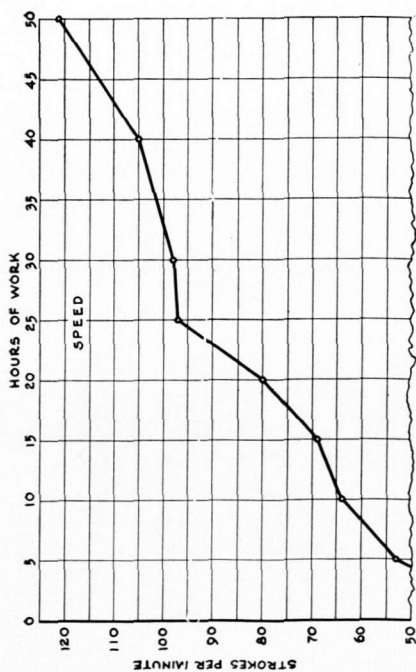


CHART VIII.—Progress curve in radiotelegraphy, average speed, 16 students

PHYSIOTHERAPY SERVICE

Final statistics from this service are very meager, consequently it has been possible to give only incomplete information as to the number of cases treated. Table 16 indicates the proportion of patients under the treatment who required attention by the various branches.

TABLE 16.—*Report of physiotherapeutic activities, General Hospital No. 6, Fort McPherson, Ga., for the year 1919*^a

Month	New patients treated	Number of aides on duty	Massage	Hydrotherapy	Electrotherapy	Remedial exercises	Total treatment given
January.....	566	20	5,603	633	855	618	7,939
February.....	595	21	4,990	2,299	1,454	395	9,138
March.....	653	25	6,814	3,317	3,344	379	13,854
April.....	526	29	6,924	3,280	3,720	7,200	21,124
May.....	509	27	7,754	7,075	5,000	9,957	29,786
June.....	554	32	4,955	6,800	4,895	8,095	24,745
July.....	547	33	8,177	6,182	3,784	6,614	24,757
August.....	497	31	11,215	5,808	4,357	8,468	29,848
September.....	431	30	7,739	2,650	2,557	5,752	18,698
October.....	616	38	10,267	3,423	3,432	9,358	26,480
November.....	727	39	8,547	2,873	3,533	7,872	22,825
December.....	347	32	6,403	2,542	2,765	5,917	17,627
Grand total.....			92,388	49,112	39,696	68,625	246,911

Average number of patients treated per day, 550; average number of aides on duty per day, 30.]

Chart X shows graphically the periods of operation of the physical reconstruction services in each hospital officially designated as a reconstruction hospital, to the end of the year 1919; also, it illustrates the concentration of the work into the first six months of that year.

Progress in improvement of the physical condition with the types of disabilities which came under the jurisdiction of the physiotherapy service was, generally speaking, easy to measure, for the improvement was mechanical as well as physical. Various devices were used to indicate accurately the motion in joints.^a The curves of normal improvements could hardly be established for the individual variations in structural conditions are limited only by the number of cases considered. Curves were plotted to record the rate and degree of improvement in individual cases, as in Charts XI, XII, XIII, and XIV.

PHYSIOTHERAPY CASE RECORDS

CASE 1.—S. H. H., Pvt., Co. D, 165th Inf., age 28 years.

Condition requiring physiotherapy.—Contraction of tendons in right leg; atrophy of muscles in left arm, shoulder, and back; adherent scars.

History previous to receiving physiotherapy.—On October 14, 1918, wounded by high-explosive shell, in left leg, left arm, and shoulder. Left leg amputated next day, upper third thigh. Sent to various hospitals in France, had influenza and pneumonia in December. Returned to United States December 24, 1918, with a stump unhealed, discharging sinuses in left upper arm, and three large bed sores. In January the right leg, entirely unaffected by wounds, began to give pain; patient sought to relieve tension by raising knee on pillow. As the tendons continued to contract, it became necessary to support knee at greater height. During this time osteomyelitis was present in left shoulder, and patient was receiving Dakin treatment.

^a See Chapter III for illustrations and other charts.—*Ed.*

General Hospitals	1918												1919											
	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Walter Reed, Washington, D.C.																								
Letterman, San Francisco, Calif.																								
Ft. Bayard, N. Mex.																								
No. 2, Ft. McHenry, Md.																								
No. 3, Colonia, N.J.																								
No. 4, Ft. Porter, N.Y.																								
No. 6, Ft. McPherson, Ga.																								
No. 7, Roland Park, Md.																								
No. 8, Otisville, N.Y.																								
No. 9, Lakewood, N.J.																								
No. 10, Boston, Mass.																								
No. 11, Cape May, N.J.																								
No. 12, Biltmore, N.C.																								
No. 13, Dansville, N.Y.																								
No. 14, Ft. Oglethorpe, Ga.																								
No. 16, New Haven, Conn.																								
No. 17, Markleton, Pa.																								
No. 18, Waynesville, N.C.																								
No. 19, Oteen, N.C.																								
No. 20, Whipple Barracks, Ariz.																								
No. 21, Denver, Colo.																								
No. 24, Parkview, Pa.																								
No. 26, Ft. Des Moines, Iowa																								
No. 28, Ft. Sheridan, Ill.																								
No. 29, Ft. Snelling, Minn.																								
No. 30, Plattsburg Barracks, N.Y.																								
No. 32, Chicago, Ill.																								
No. 34, East Norfolk, Mass.																								
No. 36, Detroit, Mich.																								
No. 38, Eastview, N.Y.																								
No. 39, Long Island, N.Y.																								
No. 40, St. Louis, Mo.																								
No. 41, Staten Island, N.Y.																								
No. 42, Spartanburg, S.C.																								
No. 43, Hampton, Va.																								
Base Hospitals																								
Ft. Sam Houston, Tex.																								
Ft. Riley, Kans.																								
Camp Custer, Mich.																								
Camp Devens, Mass.																								
Camp Dix, N.J.																								
Camp Dodge, Iowa																								
Camp Gordon, Ga.																								
Camp Grant, Ill.																								
Camp Jackson, S.C.																								
Camp Kearny, Calif.																								
Camp Lee, Va.																								
Camp Lewis, Wash.																								
Camp Meade, Md.																								
Camp Pike, Ark.																								
Camp Sherman, Ohio																								
Camp Taylor, Ky.																								
Camp Travis, Tex.																								
Camp Upton, N.Y.																								

CHART X.—United States Army hospitals functioning in reconstruction, and the periods of operation of physical reconstruction departments, 1918 and 1919

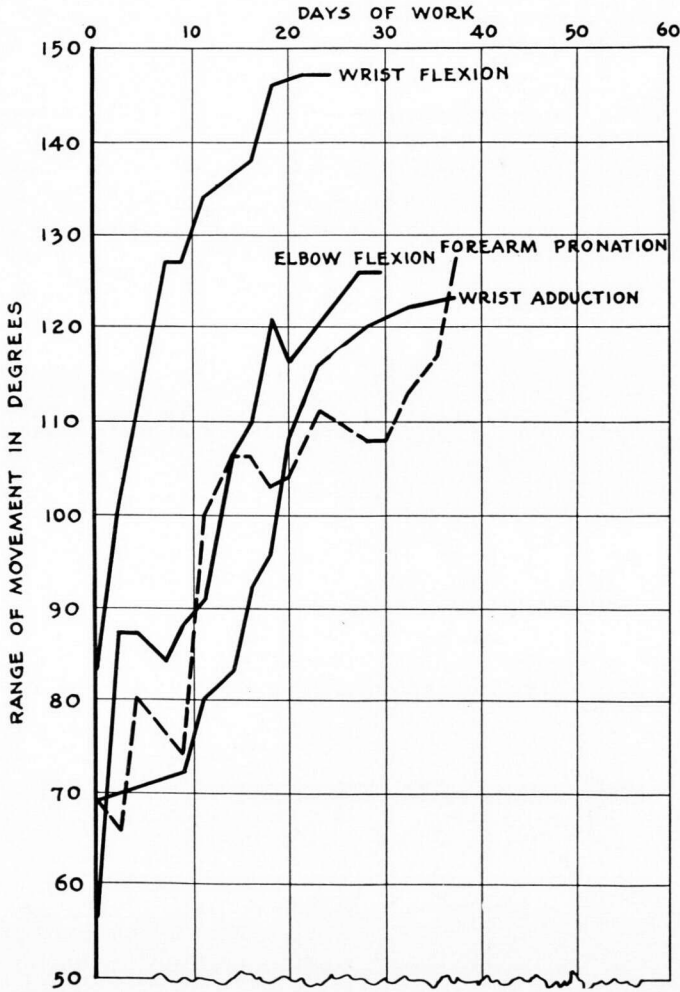


CHART XI.—Improvement curve during 37 days of typewriting and woodworking after bone graft of ulna and radius for gunshot wound, lower third, right forearm

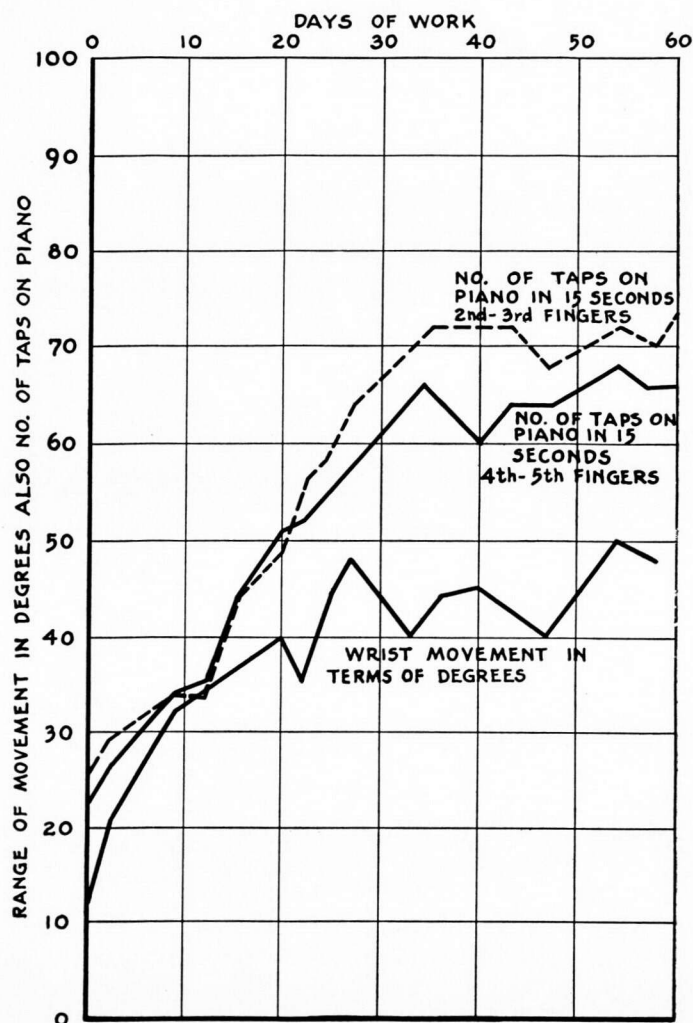


CHART XII.—Improvement curve during 61 days of typewriting, manipulation of adding machine, and automechanics prescribed for musculospiral paralysis due to fracture of right ulna

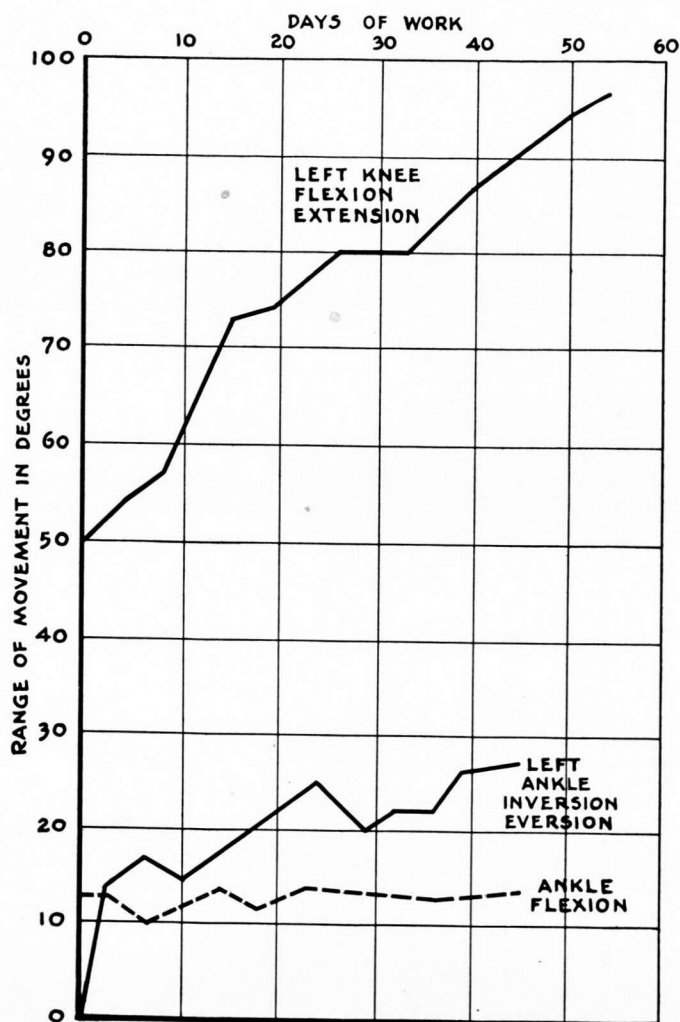


CHART XIII.—Improvement curve (a) during 55 days of work in wood shop for ankylosis of left knee; (b) during 45 days of work in wood shop for gunshot wound of left foot

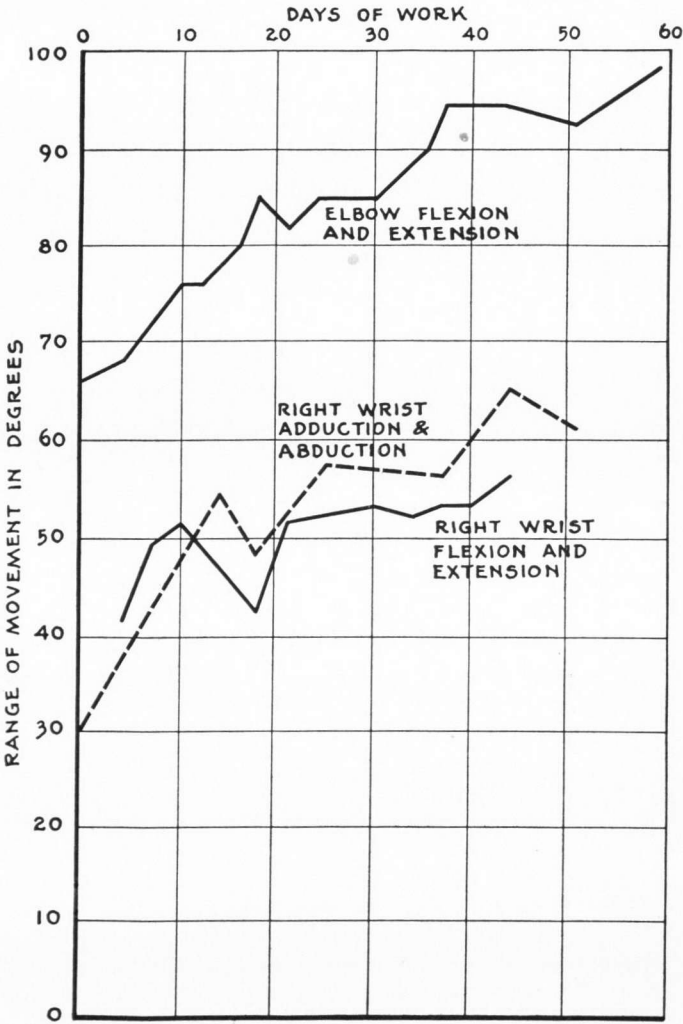


CHART XIV.—Improvement curve during 65 days of work in typewriting for musculospiral paralysis and ankylosis, right elbow

Condition at beginning of treatment in physiotherapy department.—Treatment began July, 1919. Stump unhealed; large bed sores on back and right hip; sinuses of left arm and shoulder still discharging; left shoulder ankylosed; flexion of elbow impaired by scar on posterior surface. Right leg, uninjured by wound, was by this time badly crippled; the muscles had wasted, and all tendons contracted so that the knee was bent to a right angle; foot pointed downward and toes lifted rigidly. There was marked loss of muscular power everywhere except in right arm, which necessarily had received constant exercise; the patient was unable to raise himself in bed or even to lift the right leg; the combination of unhealed stump and shoulder on left side and bed sores on back and right hip made it impossible for him to lie in any position except on the back. The right arm was the only limb remaining in normal condition.

Course of treatment in physiotherapy.—Beginning in July, 1919, the right leg received daily massage and passive stretching, the supporting pillows being removed one at a time. By October the patient kept the knee straight without discomfort, the tendo Achillis had relaxed somewhat, and the toes, though still in abnormal position, yielded under manipu-



FIG. 85.—This and Figures 86 to 89 illustrate Case I. Pvt. S. H. H.—Osteomyelitis, left shoulder, following gunshot wound. Lateral view

lation. There was also great improvement in muscular power. In October treatment of the left arm and shoulder was begun. X-ray findings showed the head of the humerus was gone and that there was bony ankylosis between the end of the humerus and the glenoid cavity. The sinuses had nearly healed. Massaged and gentle passive motions were given. The muscles responded rapidly, the movement of the scapula soon became free, and the scar at the elbow stretched sufficiently to allow nearly perfect flexion. As a result the condition of the man changed from that of absolute helplessness, in which the left arm was held rigidly by the side of the body, to one allowing the patient to dress himself, fasten his necktie, and finally to use a crutch. The bony ankylosis at the shoulder permanently limits the abduction of the arm to the point made possible by movement of the scapula—i. e., the hand can be raised about 2 feet from the side of the body. Of course rotation is prevented. During October the patient underwent an operation on the stump of left leg, and treatment was discontinued for a short time. In November the back, as well as left arm and right leg, received daily massage and exercise. By that time the man's general condition had greatly improved, but he had so far lost the use of the back muscles that he could not support himself in bed an instant, and when held in sitting position the contraction

in right leg still compelled a bent position of knee. The back responded quickly to treatment, the patient being literally reeducated to use of the supporting muscles. At the end of three weeks he could sit without props of any kind, with arms folded across chest.

Present condition and inferences.—The patient first stood erect about Christmas, after 14 months in bed. During January he had gradually come to the use of crutches, and can now walk short distances without assistance, using a crutch with his injured arm without much difficulty and lifting his foot from the floor 4 or 5 inches. Systematic massage and passive exercises have restored his left arm to its maximum usefulness, without which it would have been impossible for him to use crutches; the same treatment has restored his right leg to a condition which will soon become normal as he uses it in walking. The patient is to be discharged with "total disability," but his condition has been restored to one enabling him to lead a fairly normal and active life at home. He has been encouraged to use his

hands and arms in useful occupations; while in bed he learned basketry and produced creditable work. One point to be observed emphatically in the history of this case is that if proper massage and manipulation of the right leg had been given during the first six months of the man's illness it could in all probability have been saved from any disability whatever.

CASE 2.—W. R. W., Pvt., Co. B, 9th Inf., age 30 years.

Condition requiring physiotherapy.—Musculospiral nerve injury, right arm.

History.—Wounded by high-explosive shell July, 1918. Comminuted compound fracture of shaft of humerus. Returned to United States in November, 1918, with wounds healed; incomplete union of fracture; complete paralysis of muscles supplied by musculospiral nerve. A splint has been worn constantly since the patient was first put under treatment in France.

Treatment.—In December, 1918, the arm received massage daily. There was little improvement during the winter, the wrist-drop remaining complete. In April a neurological examination showed traumatic neuritis of the mus-

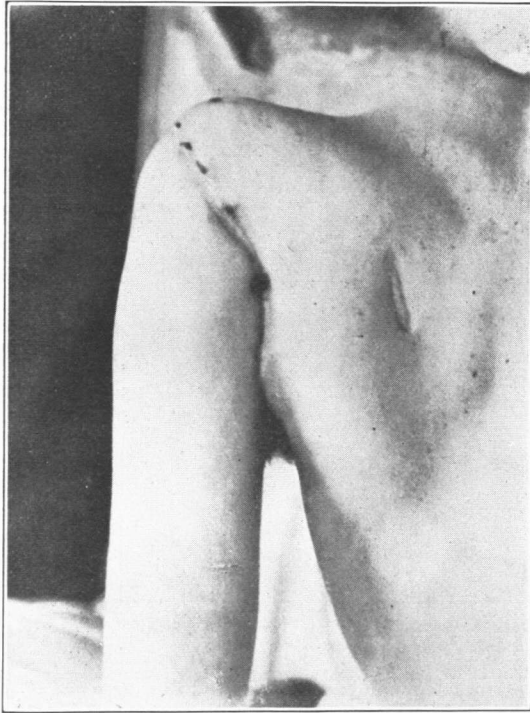


FIG. 86.—Posterior view, left shoulder

culospiral nerve with complete physiological blocking of nerve. An operation, preceded and followed by massage and electrotherapy, was advised. Beginning April 10, interrupted galvanism was applied daily. On May 6 an operation was performed—excision of the scar and end-to-end neurorrhaphy with sutures through sheath. The arm was kept in abduction splint, and massage and electrotherapy continued. Examination in September showed that the strongest galvanic test failed to cause any contraction in the paralyzed muscles; the only indication of beginning recovery was a slight extension downward of Tinel's sign. On January 17, 1920, examination shows triceps functioning with good strength, extensor carpi radialis and extensor carpi ulnaris contracting voluntarily but weakly. All other muscles supplied by musculospiral are paralyzed. Sensation has improved but little, and there is some limitation of motion in wrist and fingers, due to fibrous changes.

Conclusion.—This case has received physiotherapy constantly during its course of 19 months. The injury to the musculospiral nerve was severe and recovery is slow. The arm

and hand have been in splint constantly, and without the daily massage and passive movements probably have become ankylosed. Flexion of wrist and fingers have of course been avoided and consequently there is a decided stiffness in this regard. The muscles of arm and hand, in spite of long disuse and the wasting effects of paralysis, have been kept in good condition.

CASE 3.—Z. J., Pvt., Co. C, 125th Inf., age 30 years.

Condition requiring physiotherapy.—Musculospiral nerve injury, both arms.

History of treatment of right arm.—Gunshot wound received October, 1918, fracturing radius. Operated in March, 1919, excision of scar, division of radius at point of fracture, removal of several bone spurs, and insertion of bone peg. Up to this time there was no apparent nerve injury. The arm was in cast for three months following operation. In May, 1919, when cast was removed the arm had lost pronation and supination, and the muscles supplied by musculospiral nerve were partially paralyzed, causing wrist-drop. The conclusion was drawn that at time of operation in March the musculospiral nerve, below where the branch to the supinator longus is given off, was injured, with resulting traumatic neuritis of musculospiral nerve. Beginning in May, 1919, interrupted galvanic current was applied to the extensors of wrist and fingers daily, and the entire extremity was given a daily massage. X ray taken in September showed a knoblike growth of bone projecting from radius posteriorly and apparently uniting radius and ulna. In October the arm was operated for removal of this growth. In November, 1919, the extensor muscles were functioning, but very weakly, and there was a slight improvement in pronation and supination. Electricity, massage, and passive movements have been given daily, and during the present month of January, 1920, there has been a decided improvement in voluntary motion of the wrist and fingers and some improvement in pronation and supination. It seems probable that there will be a complete recovery from the nerve injury. The patient has worn a cockup splint on this arm since cast was removed.

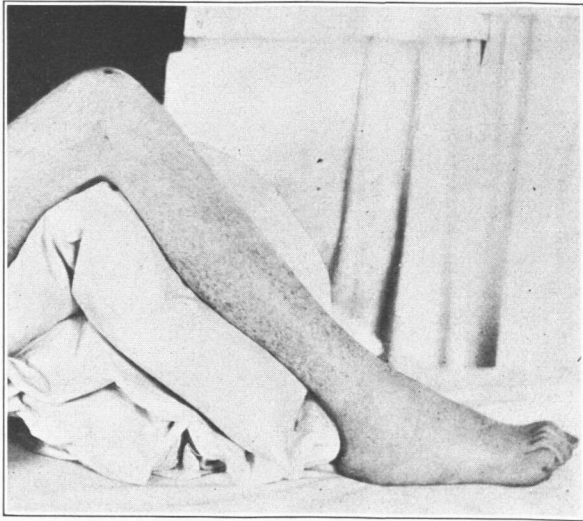


FIG. 87.—Contracture of uninjured right knee after 18 months' confinement to bed

History of treatment of left arm.—Gunshot wound received October 17, 1918, injuring soft tissues of upper arm without injury to bone; followed by paralysis of entire extremity and atrophy of all muscles supplied by the musculospiral nerve. Operated in March, 1919, excision of scars, neurolysis of musculospiral nerve adhesion of median nerve freed. In April, 1919, diagnosis showed traumatic neuritis of musculospiral nerve due to injury on inner side of arm just below axillary space. Beginning in April, 1919, interrupted galvanism and massage were given daily, and by the 1st of May, 1919, the arm had entirely recovered from paralysis, and treatment was discontinued.

Occupational therapy.—In the past few months, since this patient regained use of his hands and arms, he has occupied a large part of his time in learning to make useful articles. He joined a class in jewelry making, and the constant use of the file brought his formerly paralyzed muscles into action. Much of his spare time is spent in the carpenter shop, where he has made substantial pieces of furniture. At present he is working with a class in engineering, studying gas engines, and tractors.

CASE 4.—C. F., Pvt., 27th Co., 7th Bn., 166th Depot Brigade.

Condition requiring physiotherapy.—Musculospiral paralysis of both arms.

History of treatment.—Gunshot wound left leg, resulting in compound fracture of femur, later developing osteomyelitis requiring removal of 4 inches of bone. Was placed in cast and walked about with crutches which produced paralysis of both arms. On January 29, 1919, was referred to physiotherapy department with following diagnosis: Acute traumatic neuritis of both musculospiral nerves. Patient was given massage with interrupted galvanism and when slight voluntary movement was noticed treatment was changed to allow sinusoidal electricity. Complete recovery of both arms.

Conclusion.—The result is typical of the many cases of "crutch paralysis" which have been treated successfully.

CASE 5.—W. T. W., Pvt., Co. G, 359th Inf., age 27 years.

Condition requiring physiotherapy.—Paralysis of muscles supplied by median and ulnar nerve of right arm.

History of treatment.—Wounded September, 1918, by shrapnel, injuring right brachial plexus. Was admitted to this hospital in December, 1918, with following diagnosis: Atrophy

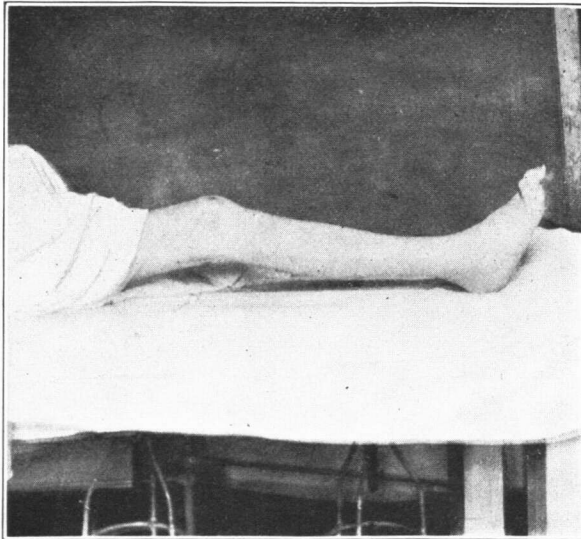


FIG. 88.—Result of five months' treatment with physiotherapy

and paralysis of all muscles of hand supplied by median and ulnar nerves, and of inner side of forearm supplied by ulnar. In the same month, December, 1918, an operation suturing the ulnar and median nerves was performed. In January, 1919, the patient was put on daily treatment of massage and interrupted galvanism, which has been continued during the entire year past. In March, 1919, the movement of shoulder and elbow was found to be normal, the small hand muscles were badly atrophied, and the possible motion of hand and wrist very weak. The patient was at this time sent to gymnasium for active exercises on the finger board. By April, the muscles in the median distribution had greatly improved in voluntary contraction, but those under ulnar

supply were still paralyzed. By November, 1919, the median paralysis had nearly disappeared and the ulnar had slightly improved. The patient is at this date, February, 1920, being discharged on his own request, in order that he may enter school. He has not reached his maximum benefit from treatment, but, with intelligent care of his arm, improvement will probably continue.

Conclusion.—This case is one of typical recovery from nerve injury. Considerable atrophy and weakness has resulted in spite of regular physiotherapy treatment, but in so complete a paralysis, these conditions would have been emphatically worse without treatment. There is no fibrous ankylosis in any of the fingers or wrist joints, and this good condition has been maintained, doubtless, by massage and passive exercises, and also in a large degree by active exercise.

Occupational therapy.—When this patient first regained partial use of his hand, he was set at active exercise on the finger boards in the gymnasium. One of these is a board cushioned with steel springs under leather. By patiently pressing these springs, the flexors of the fingers and the interossei are exercised. The other device consists of a board with a serrated

edge, up which the fingers climb, stretching to reach the highest notch possible. This exercises the extensors of the fingers.

Note.—Several months ago the patient was advised to give up these exercises and instead to spend his time learning to use the typewriter. It will be readily seen that in operating a keyboard with four tiers of characters, all the above exercises are accomplished unconsciously. This man has become a proficient typist. He intends to complete his education and without doubt his mastery of the typewriter will be a distinct help to him.

CASE 6.—F. A. V., Sgt., Co. E, 137th Inf., age 28 years.

Condition requiring physiotherapy.—Paralysis of left leg, caused by internal and external popliteal nerves.

History of treatment.—Patient received gunshot wound in popliteal space, September 8, 1918, resulting in a division of external popliteal nerve and a neuromatous degeneration of internal popliteal nerve. In February, 1919, excision of neuroma and end-to-end suture of both nerves was performed. This has been preceded and followed by interrupted galvanic treatment and massage. The first improvement was noted in July (6 months), when the posterior leg muscles contracted voluntarily, showing that the internal popliteal nerve was regenerating. The first improvement in the muscles controlled by external popliteal nerve was noted in October, 1919 (9 months). At that date all the leg muscles were functioning except the flexors of the toes. There were large areas of anesthesia and the skin over the dorsum of foot was then dry and glossy. The patient received regular treatment including massage, exercises, and interrupted galvanism. A foot-drop splint had been worn from the time of injury until October, when it was discarded during the day and worn at night. At the present date recovery is complete except for flexors of toes, extensor longus hallucis being completely paralyzed. The patient does not wear splint and walks without cane.



FIG. 89.—Final result—left shoulder ankylosed, right knee normal

Conclusion.—Typical foot-drop case in which recovery is slow and in which physiotherapy is of great value in preserving muscle tone and maintaining normal skin condition.

CASE 7.—G. W. S., Pvt., Hdqs. Co., 120th Inf., age 21 years.

Condition requiring physiotherapy.—Double thigh amputation; both hip joints mobilized under ether, following ankylosis.

History of treatment.—Wounded September, 1918, admitted to this hospital July, 1919, with stumps nearly healed and both hip joints ankylosed. During the same month both stumps were operated on for excision of scar and removal of portion of femur, allowing flap to be made. In September a daily light massage of the stump was given to improve circulation, promote healing, and to aid in drawing flesh down to make flap firm and permanent. In September, the hip joints were mobilized under anesthesia and the physiotherapist then undertook the very important task of preventing a recurrence of ankylosis. This patient

had also developed bed sores which in healing left large adherent scars on his back. These have been loosened and the back muscles improved by massage. The patient is now ready to be fitted with artificial legs.

Conclusion.—The proper massage treatment for amputation has here been followed with success. It is a case where the ward surgeon in charge fully cooperated with physiotherapy department. Massage of the stump was begun early enough to be of all possible help, and the

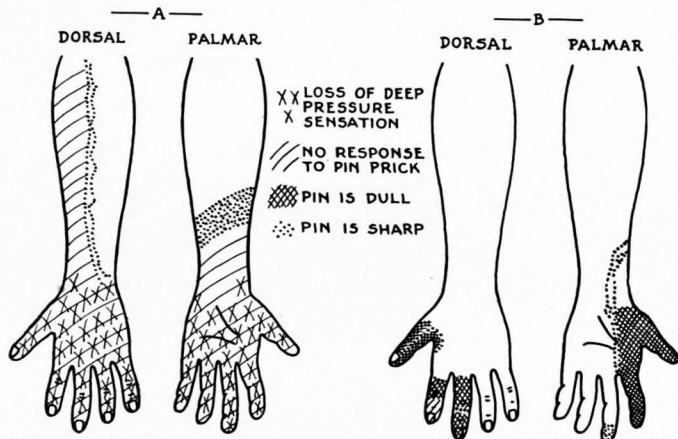


FIG. 90.—Case 9: Nerve readings made (A) before and (B) 13 months after suture of median musculospiral and musculocutaneous nerves

immediate and regular treatment of passive exercise of the hips prevented a recurrence of ankylosis.

Note.—It has been observed in numerous instances where various stiff joints have been mobilized in the operating room, that the patient has not been recommended to the physiotherapy department until all the potential good of the operation has been lost. Immediate and regular administering of passive exercise is of the utmost importance.

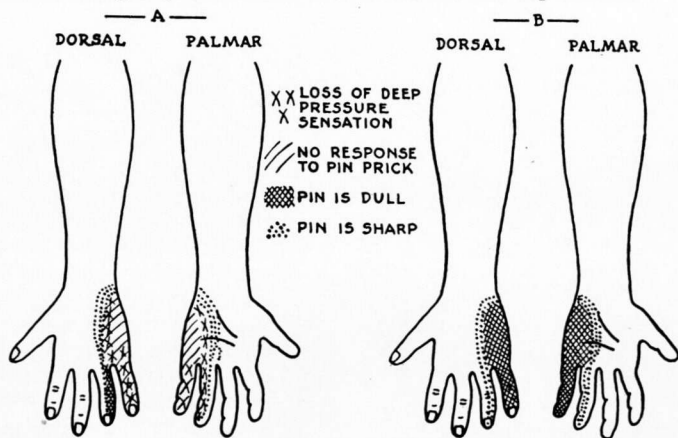


FIG. 91.—Case 10: Nerve readings made (A) before and (B) 12 months after suture of the ulnar nerve

CASE 8.—C. C., Sgt., Co. L, 11th Inf., age 29 years.

Condition requiring physiotherapy.—Paralysis of both lower extremities, caused by gunshot wounds. Injury to left sciatic nerve and right anterior crural nerve.

History of treatment.—1. Left leg—wounded by machine gun bullets, October 14, 1918. Admitted to this hospital in March, 1919, with wounds healed, all muscles of leg paralyzed. Neurological examination in March, 1919, revealed a traumatic neuritis of sciatic nerve, the

nerve not severed but probably containing neuroma. An operation was performed in March, excision of scar, neurorrhaphy, end-to-end suture of the sciatic nerve at junction of upper and middle third of thigh. In April, 1919, a daily treatment of massage and interrupted galvanism was begun. In June, 1919, the hamstring muscles had regained normal power, and there was a slight voluntary contraction in gastrocnemius and soleus, producing a distinct extension of ankle joint; all other muscles of foot and leg paralyzed; there were large areas of anesthesia. In October, 1919, the muscles supplied by internal popliteal nerve were still improving, but all others remained paralyzed. At the present date, January, 1920, the condition remains about the same. There is still a complete foot-drop, and in spite of regular treatment there has been considerable atrophy. Treatment is being continued and improvement is still expected. An external popliteal splint has been worn constantly.

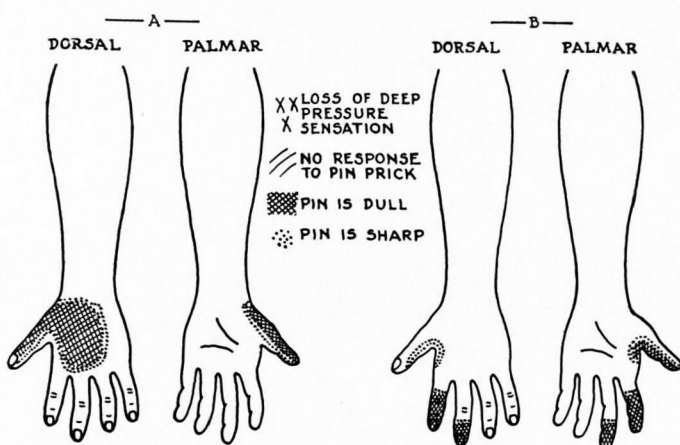


FIG. 92.—Case 11: Nerve readings made (A) before and (B) four months after suture of the musculospiral nerve

2. Right leg—injured at same time as left. Examination in March, 1919, showed a traumatic neuritis of middle branch of anterior crural nerve, the branch being completely severed. Motion was not lost, but sensation was lost in all areas governed by the nerve. By an operation in March, 1919, the nerve was sutured. Massage and interrupted galvanism were given daily beginning in April, and by June 11 improvement was so marked that treatment was discontinued.

Conclusion.—This case is a typical one of slow recovery from nerve injury. It is now 10 months since the sciatic nerve was sutured; and during this long period of waiting for the nerve to be restored, physiotherapy has done everything possible to keep the muscles in good condition and the joint movement normal.

CASE 9.—Diagnosis.—Gunshot wound left shoulder causing injury to brachial plexus. Figure 90, A. Nerve reading taken before suture of median, musculospiral, and musculocutaneous nerve. Paralysis of all muscles of hand, forearm, and arm. This patient received interrupted galvanism, slow sinusoidal electricity, and massage. The above treatment was continued for 13 months.

FIG. 93.—Case 12: Nerve readings made before suture of sciatic nerve; deep pressure sensation absent in shaded area

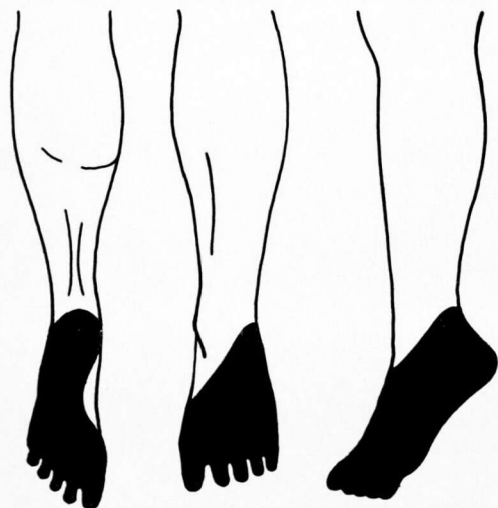


Figure 90, B, reading taken 13 months after treatment shows all muscles functioning normally except the muscles supplied by the median nerve which are beginning to show slight function, especially the sublimis digitorum.

CASE 10.—*Diagnosis*.—Gunshot wound upper arm severing ulnar nerve. Figure 91, A, diagram showing nerve reading just before suture. Figure 91, B, showing nerve reading 12 months after suture. In this interval of 12 months the patient received interrupted galvanic followed by slow sinusoidal electricity, and at intervals electricity was discontinued and contrast whirlpool arm baths were substituted.

CASE 11.—*Diagnosis*.—Gunshot wound upper arm severing musculospiral nerve. Figure 92, A, nerve reading was made just before suture of the nerve. Figure 92, B, in four months patient had regained sensation and use of muscles supplied by the musculospiral nerve. Recovery complete.

CASE 12.—*Diagnosis*.—Gunshot wound lower thigh severing sciatic nerve. In Figure 93, the black area shows where deep pressure sensibility is lost. The reading was made just

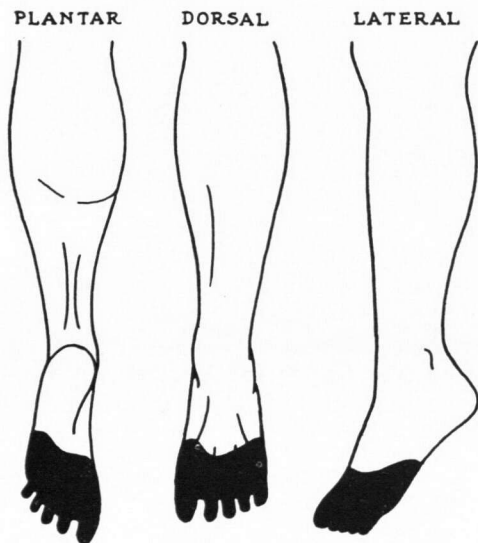


FIG. 94.—Case 12: Nerve readings made six months after suture of sciatic nerve; deep pressure sensation absent in shaded area

before suture. Paralysis of all muscles supplied by sciatic nerve. This case received electricity and massage and short intervals of contrast whirlpool baths. After six months' treatment the nerve reading, Figure 94, shows a gradual disappearance of the dark area, which means that sensibility to deep pressure is returning with normal action of the gastrocnemius muscle. Patient later had complete recovery of sensation and movement of all muscles of the leg.

FINAL RESULTS

The following data may be taken as a measure of the final results of reconstruction work in the United States Army hospitals: Of 15,449 men who were discharged from the service on certificate of disability, 0.87 per cent were totally disabled, 7 per cent required further training in order to resume their old occupa-

tions, and 92 per cent required no further treatment in order to resume their old occupations.⁴

REFERENCES

- (1) Based on educational service reports sent to the Office of the Surgeon General. On file Record Room, S. G. O., 353.91-1.
- (2) Letter from First Lieut. Charles L. Harlan, San. Corps, Education Service, Base Hospital, Camp Dix, N. J., to Maj. Arthur G. Crane, San. Corps, June 12, 1919. Subject: Progress Curves in Radiotelegraphy, Wire Telegraphy, and Mechanical Drawing; also attached documents. On file, Historical Division, S. G. O.
- (3) Report of the activities of the physiotherapy department, Fort McPherson, Ga., 1920 by Capt. Charles L. Ireland, M. C. On file, Historical Division, S. G. O.
- (4) Evans, H. M.: Physical reconstruction in United States Army hospitals. *The Military Surgeon*, Washington, 1920, xlv, 33-39.

PART TWO

PART TWO

THE ARMY NURSE CORPS

CHAPTER I

IN THE UNITED STATES

ORGANIZATION

The organization of the Army Nurse Corps, as it functioned during the World War, was based upon the following extract of act of Congress, February 2, 1901:¹

SEC. 19. That the Nurse Corps (female) shall consist of one superintendent, to be appointed by the Secretary of War, who shall be a graduate of a hospital training school having a course of instruction of not less than two years, whose term of office may be terminated at his discretion, whose compensation shall be \$1,800 per annum, and of as many chief nurses, nurses, and reserve nurses as may be needed. Reserve nurses may be assigned to active duty when the emergency of the service demands, but shall receive no compensation except when on such duty: *Provided*, That all nurses in the Nurse Corps shall be appointed or removed by the Surgeon General, with the approval of the Secretary of War; that they shall be graduates of hospital training schools, and shall have passed a satisfactory professional, moral, mental, and physical examination: *And provided*, That the superintendent and nurses shall receive transportation and necessary expenses when traveling under orders; that the pay and allowances of nurses, and of reserve nurses when on active service, shall be \$40 per month when on duty in the United States and \$50 per month when on duty without the limits of the United States. They shall be entitled to quarters, subsistence, and medical attendance during illness, and they may be granted leaves of absence for 30 days, with pay, for each calendar year; and, when serving as chief nurses, their pay may be increased by authority of the Secretary of War, such increase not to exceed \$25 per month. Payments to the Nurse Corps shall be made by the Pay Department.

THE SUPERINTENDENT

As outlined in the Manual for the Medical Department, United States Army, 1916, the duties of the superintendent of the Army Nurse Corps were as follows:

The superintendent, under the direction of the Surgeon General, has general supervision of the corps. She will, by authorized inspections from time to time and by reference to the prescribed reports and returns, keep herself constantly informed of the numbers, distribution, and competency of the individual members of the corps, and of its state and condition as a whole. She will communicate with nurses' training schools, nurses' associations, and similar professional bodies with a view to ascertaining where acceptable nurses for Army service may be available; will conduct the necessary correspondence concerning the qualifications of applicants for appointment in the corps; will make the professional examination of those who shall meet the required preliminary conditions; and when vacancies occur will recommend the appointment to the same of eligible applicants. She will prepare the questions for the examination of nurses for promotion to the grade of chief nurse, will rate the answers received thereto, and will recommend the promotion of those found qualified as their services shall be needed. She will make timely recommendations regarding the assignment, transfer, discipline, and discharge of chief nurses. She will endeavor by all suitable means within her power to maintain the usefulness of the corps as a part of the Medical Department of the Army, will propose to the Surgeon General as occasion requires appropriate measures for the promotion of its morale and efficiency, and will perform such other supervisory duties as the Surgeon General shall prescribe.

CHIEF NURSES

Chief nurses were not to be appointed as such, but were to be selected by promotion from the grade of nurse.² A chief nurse invariably was to be assigned to duty when two or more nurses were serving at the same station.² On the other hand a chief nurse was not to be assigned to duty permanently, except by the Surgeon General, upon the recommendation of the superintendent of the Army Nurse Corps.³ Nor was a nurse to be assigned permanently to duty as chief nurse until after she had passed a satisfactory examination.

Nurses who exhibited marked executive ability, good judgment, and tact were to be recommended to the Surgeon General by the commanding officer of a hospital or other Medical Department formation with which they were on duty for examination for promotion to the grade of chief nurse.

NURSES

Applications for appointment in the Nurse Corps, were to be made to the superintendent of the corps on proper blank forms furnished by the superintendent. As to other requirements, these were detailed as follows:⁴

* * * * * *

(a) An applicant for first appointment must be between 25 and 35 years of age and unmarried. If not a citizen of the United States, she must before appointment make a declaration of her intention to become such, and, if she wishes to continue in the Nurse Corps, must at the proper time take out final naturalization papers.

(b) Applications from States and Territories where registration is required by law will be considered in the cases only of graduates of training schools which are acceptable to the State or Territorial boards of registration. In making appointments from among eligible applicants residing in such States and Territories preference will be given to those who are registered.

(c) Nurses who have had previous service in the Army Nurse Corps and are otherwise acceptable will be given preference for appointment over new nurses who qualify for the corps.

63. *Physical qualifications.*—The applicant's physical fitness for service will be ascertained by a careful physical examination. The examination will be made when practicable by a medical officer of the Army at his proper station. When, however, this would require the applicant to make an unreasonably long journey, the Surgeon General may authorize her examination by a private physician of good repute in the vicinity of her residence. The applicant must be not less than 60 inches nor more than 70 inches in height; and must weigh not less than 100 pounds, nor more than 195 pounds. Marked disproportion between height and weight will be a cause of rejection. The medical examiner will send his report direct to the superintendent and not give it to the applicant. Its contents will be regarded as confidential.

64. *Moral, professional, and mental qualifications.*—An applicant will not be eligible for appointment in the Nurse Corps unless she shall have graduated from a training school for nurses giving a thorough professional education, both theoretical and practical, and requiring a residence of at least two years in an acceptable general hospital of 100 beds or more; except that graduates of training schools connected with hospitals not meeting the above requirements may, upon submitting proof of at least six months' subsequent experience in a large general hospital, be put on the eligible list if found otherwise qualified. To ascertain the applicant's qualifications the superintendent of the Nurse Corps will request a certificate from the superintendent of the school from which the applicant graduated, showing: (1) The date of the applicant's graduation; and (2) her moral character and professional qualifications during her period of training, at the date of her graduation, and (so far as known) at the time of the application. If the applicant was trained under a former superintendent, the latter may also be asked for a certificate. These certificates will be regarded as confidential. Applicants must submit such other evidence of fitness as may be required.

(a) The professional and mental examination of applicants will be in writing and will be conducted by the superintendent. It will ordinarily take the form of requiring from the candidates short essays or papers on practical professional subjects selected by the superintendent. The subjects selected will be furnished to each applicant with her application blanks and she will submit her essay with her formal application. The essay must be in the handwriting of the applicant. Typewritten papers will not be accepted.

65. Applicants who fulfill the prescribed conditions as to their physical, moral, professional, and mental qualifications will be placed on the eligible list for appointment as their services may be required.

66. No applicant will be appointed unless she shall agree to serve for three years.

67. A nurse who desires to continue in the corps after three years' service therein will apply for continuation of service by letter forwarded at least four months before the end of the three years to the Surgeon General, through the commanding officer of the hospital or other sanitary formation to which she is attached, who will forward therewith his recommendations in the premises and the recommendations of the chief nurse. If the recommendations of her commanding officer are unfavorable the nurse will be promptly notified of that fact. To obtain favorable action on such application the nurse must have had a satisfactory record for efficiency and conduct. The superintendent of the Nurse Corps will advise the Surgeon General whether the applicant's record is such as to make her continuance in the corps desirable. Due notice will be given to the applicant and officers concerned of the action taken upon the application.

(a) A similar procedure for continuation of service will be followed toward the end of every period of three years of continuance in the corps.

From the time of its establishment by law in February, 1901,¹ up to the entry of the United States into the World War, the Nurse Corps had functioned evenly and without any radical change until the Mexican border uprising in 1916, when reserve nurses were assigned to the Army Nurse Corps to augment its numbers.⁵ This brought the membership from approximately 160 to 450.⁵ By April 6, 1917, after a short period of demobilization, 403 nurses remained in the Army Nurse Corps, of whom 233 were reserve nurses obtained through the American Red Cross.⁵

OFFICE OF THE SUPERINTENDENT OF NURSES

At the time the United States declared war on Germany, the office of the superintendent of nurses, in the Surgeon General's Office in Washington, consisted of the superintendent of the corps and one clerical assistant, who occupied a very small space in a corridor of the State, War, and Navy Building. As the corps numbers increased, the detailed paper work increased, and called for more clerks and greater office space. Each week during the earlier months of the war, brought more clerks to the Nurse Corps section, until in May, 1918, when the entire Surgeon General's Office was moved to one of the Government temporary structures, Unit F Building, at Seventh and B Streets NW., where the office of the superintendent of the Nurse Corps occupied nearly all of one floor of a wing of this building. At one period during the war the staff consisted of the superintendent, 2 chief nurses, 19 nurses, and 75 clerks.⁶

In March, 1918, a chief nurse was assigned to duty in the Nurse Corps section to assist the superintendent in professional and administrative matters.⁷ On July 9, 1918, Congress made provision for six assistant superintendents who were to be appointed by promotion from other grades of the corps.⁸ Under

this authority 3 assistant superintendents were appointed September 5, 1918,⁹ and 2 more on December 26, 1918,⁵ as 1 former one had requested demotion from this grade on account of her health,⁵ and 1 had died.⁵

The Army Nurse Corps section of the Surgeon General's Office was an extremely busy section, throughout this time. All applications for service in the Nurse Corps, submitted through the Red Cross Bureau of Nursing Service, as well as those sent directly to the superintendent of the Nurse Corps had to be acted upon individually, particularly with reference to the physical examinations of the nurses, both before and after appointment. There were scores of letters from chief nurses, filled with their problems centering about Army customs, housing, feeding, and the maintenance of morale. Constant inquiries poured in from all sections of the country and beyond, concerning Army service; offers were received from women of all ages in all stations of life, either with or without nurses' training. Each day brought its quota of interviewers, reporters, and applicants for service. Countless telephone calls, conferences, preparation of speeches, articles, and publicity material, questions of transportation, epidemics which called for additional personnel at once, uniforms, interpretation of regulations, to say nothing of occasional complaints, were some of the matters that made each day a more than busy one.

EXPANSION

After the outbreak of war, and the camps and cantonments, with their necessary hospital facilities, were being established at an amazing rate, it was necessary to take steps which would afford a greater supply of nurse personnel. Early in December, 1917, an article was inserted in the newspapers of the country through the publicity committee of the War Department, setting forth the urgent need for nurses in the Army hospitals,⁵ and a form letter stating that it was estimated that 20,000 nurses would be needed by the Army in the following year was mailed on December 4 to all schools of nursing, nursing associations, and central directories.¹⁰ In less than a month over 2,000 replies had been received by the Surgeon General's Office.¹¹ On January 25, 1918, the committee on public information prepared a memorandum for the Secretary of War, in which it was stated that approximately 30,000 nurses would be needed for Army service during 1918, and that it was believed that the supply of graduate nurses in the country would be sufficient without calling upon any who were not graduates.¹² As a result of the wide publicity given the need for nurses, applications poured in by the hundreds, and a growing clerical force was kept busy rushing transportation orders to the new appointees.

From the nucleus of 403 nurses in the Army Nurse Corps in April, 1917, was developed a corps which at its peak in November, 1918, numbered 21,480.⁵ Nurses were assigned to duty at the cantonment hospitals, general hospitals, and at many hospitals connected with the Coast Artillery posts, aviation stations, recruit camps, and ports of embarkation, located in all parts of the country.⁵

RATIO OF NURSES TO PATIENTS

Nurses were assigned to hospitals in the ratio of 1 to 10 beds, the assignments being made from time to time on requisition for them by commanding officers of hospitals.¹³

QUALIFICATIONS FOR ELIGIBILITY

As stated above, in time of peace, regulations required that nurses eligible for appointment in the Army Nurse Corps be citizens of the United States between 25 and 35 years of age, and unmarried.¹⁴ With the waiving of certain requirements, the age limit was extended to include the ages of 21 and 45, and nurses who were citizens of allied countries were declared eligible, provided they met the other requirements.¹⁵ The provision that nurses must agree to remain in the corps for three years was altered so that they could serve for the period of the emergency instead of for three years if they elected to do so.¹⁵ The moral and professional qualifications have been quoted above; no changes were made as regards professional qualifications during the period of the war.

CITIZENSHIP

Many questions arose in the office of the superintendent of the Nurse Corps concerning citizenship requirements of nurses. The decision made was that citizens of the United States, native or naturalized, were alike acceptable for service, and that no discrimination should be made as far as the matter of obtaining citizenship was concerned, if the loyalty and fidelity were unquestioned. It should be noted here that it was thought best not to assign to units that were serving under the allied forces nurses from alien enemy countries who were naturalized citizens or who bore names strongly suggestive of such alien enemy origin.¹⁵

SPECIAL TRAINING

Especial note was made of any particular qualifications possessed by nurses, such as experience in the administration of anesthesia, psychiatric nursing, and orthopedic work. Specialist nurses entered the corps under the same terms as did other nurses, and so far as was possible, were assigned to duty where there was need for specialized services.

ANESTHETIC SERVICE

The demand for expert anesthetists led to an arrangement by which several members of the corps were sent to the Mayo clinic, St. Mary's Hospital, Rochester, Minn., to take a course in the administration of anesthesia.¹⁶ For six weeks during April and May, 1918, five nurse members of a mobile operating unit were detailed to the Mayo clinic for an intensive course in anesthetics.¹⁷ Again, early in September, 1918, 15 nurses from several cantonments were sent to Rochester to receive instruction, after which they returned to their own stations to instruct other nurses, officers, and corps men.¹⁸ The object of this training was to supply an adequate number of specialists in anesthesia administration for the benefit of the surgical service both in the United States and overseas.

On September 23, 1918, the Acting Surgeon General wrote to the commanding officers of various hospitals, directing them to build up a strong department of anesthesia, by training hospital personnel by some particular person designated in the respective letters.¹⁹ Nurses who subsequently took such a course were rated on their proficiency by their commanding officers, and the reports were submitted to the superintendent of the Army Nurse Corps.²⁰

COLORED NURSES

Before the World War, no colored nurses had ever served in the Army Nurse Corps. Many of them, however, were anxious to join the corps if arrangements could be made, because of the relatively large number of colored troops in the Army, and as early as December, 1917, they were in communication with the director of the American Red Cross bureau of nursing service, offering their services.²¹ The superintendent of the Army Nurse Corps advised that they be permitted to enroll in the American Red Cross, but that they be made to understand that their assignment as reserve nurses in the Army was uncertain.²² The question of separate quarters for them was the greatest problem in connection with their appointment.²³ However, in July, 1918, tentative plans were made to send colored nurses in groups of 20 to several posts which had large numbers of colored troops.⁵ The American Red Cross was asked on July 16, 1918, to submit the names of 40 colored nurses for service in the United States.²⁴ Delays in the provision of separate quarters and mess for these women resulted in their not being assigned to duty until after the signing of the armistice, when Camp Sherman, Ohio, and Camp Grant, Ill., were each supplied with nine colored nurses.²⁵ One of these women was relieved from service shortly after her assignment because of ill health, but the others remained until the summer of 1919, when the reduction of the nursing force necessitated their release.²⁶ In the fall of 1918 a few colored nurses were employed locally for emergencies at Camp Pike, Ark.,² and Camp Sevier, S. C.²⁷

CUBAN NURSES

In April, 1918, the chief of the bureau of nursing, Habana, Cuba, wrote to the Surgeon General of the Army, offering the services of a small group of graduate nurses of Cuba, for duty in the Army hospitals of the United States.²⁸ On July 18, 1918, The Adjutant General of the Army notified the Surgeon General that the Secretary of War had authorized the assignment of Cuban nurses to the nursing service of the Army in Porto Rico, and directed that he confer with the chief of the Cuban Nurse Corps regarding the details of this service.²⁹ However, early in August, 1918, before any further action was taken in the matter, the chief of the bureau of nursing in Cuba wrote to the superintendent of the Army Nurse Corps asking to be allowed to withdraw the offer which in April she had made, to place at the disposal of the Surgeon General a small group of Cuban nurses. She stated that the obligatory military service bill had become law in Cuba, and the supply of nurses in Cuba was not adequate to serve both with their own troops and with those of the United States.³⁰

CIVILIAN NURSES

For many years the employment of civilian nurses in Army hospitals had been authorized by regulations,³¹ and during 1918, this authorization was used in the employment of nurses under contract, to supplement the Army Nurse Corps.⁵ They were employed in large numbers by the commanding officers of Army hospitals during the influenza epidemic of 1918. At that time, in response to many inquiries, the Surgeon General sent telegrams to all general hospitals, base hospitals, department surgeons, and surgeons at ports of embarkation,

which stated that to meet the emergency conditions, civilian nurses might be employed locally at \$75 per month, with a subsistence allowance of one ration a day, lodging, laundry, transportation, and \$4 a day in lieu of traveling expenses on joining their first station and on returning home from their last station.³² Nurses who were not graduates, and nurses' assistants who might be employed during the emergency, would be given from \$30 to \$50 a month, according to their experience, with the same allowances as the graduate nurses.³²

Besides these contract nurses, there were certain others who, because of their experience in civilian hospitals and special qualifications, were authorized to make inspection trips to various cantonment hospitals.³³ They submitted reports to the Surgeon General on the conditions found at the various posts, and offered recommendations based on their observations.

A number of other nurses served under contract as instructors in the Army School of Nursing.³³ There were numerous reasons why many of these women could not be appointed in the Army Nurse Corps, but because of their age, education, and experience, they were highly desirable in the various branches of the School of Nursing. Many of them left important positions in civilian schools of nursing to enter these contracts.

Certain other contract nurses were on duty in Washington, D. C., under the jurisdiction of the Army attending surgeon. They served in the dispensary and emergency rooms and as visiting nurses.³³

The selection and employment of the contract nurses who made inspections and also of the instructors were handled by the Army Nurse Corps section, but in the case of civilian nurses at posts to meet emergency conditions, these matters were arranged locally.

INCREASE OF AVAILABLE NURSE POWER

The committee on nursing of the general medical board of the Council of National Defense lent its efforts toward an expansion of the nursing forces of the Government.³⁴ Since graduate nurses only were eligible for military service, the civilian supply of the country was becoming seriously depleted. In previous wars the solution to the problem had been found in accepting women for service who had had short period of training as aides, and during the early part of the World War it had been contemplated sending 25 such aides abroad with each hospital unit.³⁴ Before this was accomplished, however, the British and French Governments requested that only graduate trained nurses be sent overseas.³⁴ In order to increase the available nurse power, the committee then began a campaign for students to enter schools of nursing, and by April, 1918, 7,000 more students than usual had entered training schools in the United States.³⁴

NURSES' AIDES

In December, 1917, the question of the advisability of training nurses' aides for duty in Army hospitals to offset the possible shortage of nurses, was discussed at a meeting of the nursing committee of the Council of National Defense, but at this time it was decided to let the matter rest until a more immediate need should be indicated.⁵ On January 24, 1918, the Surgeon Gen-

eral advised the Secretary of War that it was not planned at that time to employ any but graduate nurses in Army hospitals, but that should a shortage of graduate nurses occur, steps would be taken to establish courses for nurses' aides in civil hospitals in the United States. Candidates for such courses would be selected from among young women who had taken the course in home care of the sick and in elementary hygiene under the American Red Cross, and also from among other women who were considered suitable.³⁵

It was believed that a practical course of not less than one month in an approved general hospital that had at least 50 beds would be sufficient preparation for the aides who would be selected to serve in military hospitals. After further details were settled regarding the training to be given them, it was announced that such aides would not be called upon for service until the supply of graduate nurses became inadequate to meet the need.⁵ However, in September, 1918, the commander in chief, A. E. F., asked for 1,250 nurses' aides for service overseas.³⁶ As a result of this request the Surgeon General, on November 2, 1918, requested that the director of the American Red Cross Bureau of Nursing Service recruit 1,500 nurses' aides for service overseas, who should be between the ages of 30 and 45 years, and unmarried.³⁷ Plans were consummated relative to the uniform to be worn by such employees, and appointment forms were prepared in the Surgeon General's Office. Before any aides were sent overseas, however, the signing of the armistice occurred, and the American Red Cross was notified that in all probability nurses' aides would not be called into service either in this country or abroad.³⁸

THE ARMY SCHOOL OF NURSING

In February, 1918, the chief inspecting nurse of the Army made her first trip of inspection to the Government military hospitals, and after this trip made the recommendation that an Army School of Nursing be established which would provide for the patients in Army hospitals the kind of student care that is provided in civil hospitals.³⁴ Following consultations between the superintendent of the Nurse Corps and many authorities in nursing education, including medical men and women holding important positions in their professions, and upon their recommendation, on March 30, 1918, the Surgeon General requested authority of the Secretary of War for the establishment of such a school, but this request at this time was disapproved.⁴¹ The recommendation was repeated on May 24, 1918, and the establishment of the Army School of Nursing was approved by the Secretary of War on May 25, 1918.⁴² On this same date the chief inspecting nurse was appointed director of the Army School.⁴³ The order so appointing her was amended on May 27, 1918, to read "dean" of the Army School.^{44 a}

PUPIL NURSES

At the same time at which he requested nurses' aides for service abroad, the commander in chief, A. E. F., requested that 25 (or more if possible) second or third year pupil nurses be sent overseas from each of the parent

^a The activities of this school have been incorporated in Volume VII, Training, Chapter VI, p. 441.

institutions attached to the Base Hospitals Nos. 1 to 50, abroad.³⁶ This was according to a plan inaugurated by the Medical Department, A. E. F., by which it was hoped a solution to the problem of an adequate supply of nurses had been acquired. This plan had been outlined in August, 1918, in letters to the parent institutions connected with the base hospitals, from the Surgeon General.³⁹ On October 16, 1918, the Surgeon General informed the dean of the Army School of Nursing that he approved the policy of sending student nurses overseas and that it was desirable to take steps to enroll students for such duty.⁴⁰

CHIEF NURSES

As stated above, one chief nurse must be on duty wherever two or more nurses might be serving; consequently, with the rapid opening of new camps and cantonments in 1917, and the assignment of nurses to the hospitals there, a great many chief nurses had to be appointed. In so far as it was possible to do so, candidates for chief nurseship were selected from women already in the corps, but during the earlier months of the war such a source of supply could not begin to meet the demand. Fortunately, hundreds of leaders in the nursing profession in civil life eagerly responded to the summons when the matter was brought to their attention. They entered the Army Nurse Corps either directly or through the American Red Cross nursing service;⁴⁵ a brief period of service in the case of most of the nurses gave them the necessary knowledge of Army methods. The American Red Cross nursing service was on the alert to recognize and recommend nurses whose experience indicated executive ability.

During the winter of 1917-18 the superintendent of the Nurse Corps repeatedly wrote to the various chief nurses of the Army, urging them to be on the lookout for possible chief nurse material, and instructed them to have such nurses make request to be examined for promotion.⁴⁶ She impressed upon them the fact that many chief nurses would be needed overseas in the near future, and that the need was acute.

CHIEF NURSE EXAMINATION

At the time war was declared, the examination for promotion to the grade of chief nurse was given in elementary hygiene, arithmetic, and pertinent questions concerning the Manual for the Medical Department, United States Army.⁴⁷ The main points considered, however, aside from the technical questions of the Manual, were executive ability, good judgment, and tact. The reserve nurses who were sent abroad in charge of the nurses of base hospitals were not required to take the examination prescribed for the regular corps, but the professional standing of these nurses in their own communities had great weight in the minds of those who appointed them. These latter points were not deemed any less important when, in June, 1918, the examination was limited to questions on the Manual for the Medical Department.⁴⁷

The questions in the chief nurse examination were prepared by the superintendent and the replies were graded by her.⁴⁸ The examination had to be taken under the supervision of a medical officer, deputized by the commanding officer of the hospital, to conduct the examination.⁴⁹ If the applicant passed the examination and was needed in chief nurse capacity, she was appointed to

that grade and given a station at once.⁴⁹ The duties of an Army chief nurse are similar to those of a superintendent of nurses in a civil hospital. She has charge of nurses' quarters and mess, and the arrangement of hours of duty and the assignment of nurses. In addition to this she must prepare numerous reports and have charge of all correspondence with the Surgeon General's Office pertaining to the nursing personnel at her station.⁵⁰

DISTRIBUTION

ASSIGNMENTS TO HOSPITALS

At the outbreak of war nurses were stationed in 4 general hospitals, 5 base hospitals, 5 camp hospitals, 1 hospital train, in the Attending Surgeon's Office, Washington, and in the Surgeon General's Office.^{5 a} The weekly report made at the time the armistice was signed showed that nurses were on duty in 37 general hospitals, 3 department base hospitals, 35 camp base hospitals, 41 hospitals at posts, arsenals, and recruiting depots, 5 embarkation hospitals, 3 debarkation hospitals, 36 aviation stations, and 9 miscellaneous stations in the United States.⁵

ARMY NURSES ON TRANSPORTS

On June 10, 1919, the chief of the Transportation Service requested that Army nurses be assigned to duty on trans-Atlantic transports.⁵¹ To this request the Surgeon General replied that the department was willing so to assign nurses, to be selected from among those at the ports of embarkation, to give professional care to passengers on transports.⁵² Thereafter, until November 15, 1919, nurses for transport duty were drawn from the Port of Embarkation, Hoboken, N. J.,⁵³ but on that date authority was given by the Surgeon General to obtain nurses for transports from General Hospital No. 41, Fox Hills, Staten Island, N. Y.⁵⁴ The chief nurse of the hospital had charge of the selection of nurses for transport duty, a detail much desired by the majority of nurses. When two or more nurses were assigned to the same transport, one of them was designated supervising nurse, but this duty did not call for the grade or pay of a chief nurse.⁵⁵

THE RUMANIAN EXPEDITION UNIT

Early in November, 1917, the acting chairman of the American Red Cross war council advised the Surgeon General that he had received the approval of the Secretary of War for the organization of an expedition of 100 Army medical officers for service in Rumania.⁵⁶ The request from Rumania included not only medical officers but nurses also.

On November 14, 1917, the Secretary of War approved the Surgeon General's recommendation that 12 nurses be sent with the unit of medical officers to Rumania;⁵⁷ and on November 16, 1917, the superintendent of the Army Nurse Corps requested the director of the American Red Cross bureau of nursing service to nominate 10 reserve nurses for duty in Rumania, as it was expected that they would sail with the medical officers of the unit on December 5 from San Francisco.⁵⁸ An Army chief nurse and another member of the

^a Nurses were stationed also at hospitals in our foreign possessions.

Regular Nurse Corps were ordered with the 10 reserve nurses whose names had been proposed by the American Red Cross. The group left San Francisco on the U. S. Army transport *Sheridan*, expecting to go to Rumania by way of Manila and Hongkong.⁵⁹ However, by the time they had proceeded 50 miles out to sea, a cablegram was received directing them to return to await further orders.⁶⁰ Accordingly, the unit reported at the Letterman General Hospital, San Francisco, Calif., to await War Department decision in the matter.⁶¹ On December 28, 1917, The Adjutant General advised the commanding officer of the unit that no nurses would sail with the Rumanian expedition,⁶² and subsequently the plan for sending any Medical Department personnel was abandoned.⁶³

THE ITALIAN UNIT

Base Hospital No. 102 was organized in the summer of 1918.⁶⁴ The personnel included 36 medical officers, 100 graduate nurses, 10 of whom were Sisters of Charity, 1 dietitian, 2 stenographers, and 2 laboratory technicians.⁶⁴ When the nurses and Sisters of Charity of this hospital reported to the American Red Cross equipment bureau in New York City, the question arose as to the uniform to be worn by the Sisters of Charity.⁶⁴ They insisted that they had entered the service with the understanding that they might be allowed to retain the garb of their order, and for that reason it was decided to permit them to do so.⁶⁴ War Department instructions, issued shortly afterwards, specified that Army nurses who were members of Catholic orders might wear their distinctive garb while traveling and that when such garb was worn they should also wear a device to mark them as members of the Army Nurse Corps.⁶⁵ While on duty they would be required to wear a distinctive cap prescribed by the Surgeon General.⁶⁵

On August 4, 1918, Base Hospital No. 102 unit sailed from Baltimore, Md.⁶⁴ The hospital was located at Vicenza, Italy, where it functioned for seven months.⁶⁴

PORTO RICAN DUTY

Early in June, 1918, 49 nurses and 1 dietitian mobilized at New York City for duty in Porto Rico.⁶⁶ They sailed July 20, 1918, and after an uneventful five-day trip reached San Juan, Porto Rico. The chief nurse of this group informed the superintendent of the Army Nurse Corps that their hospital was a very large, spacious building, fitted up much more completely than some of the camp hospitals in the United States. On the other hand, the group experienced great difficulty in obtaining supplies, many things they could not get, and what they could get was so high a price as to be almost prohibitive.⁶⁷

Social life in connection with Army service in Porto Rico helped to compensate for the difficulties encountered, so, on the whole, the nursing service was enjoyable, and it was with pleasant memories that on January 20, 1919, the unit returned to the United States after six months' service.⁶⁷

THE SIBERIAN UNIT

In September, 1918, plans were made to send Base Hospital No. 93 to Siberia for duty with the American Expeditionary Forces there.⁶⁸ One hundred nurses and one dietitian were designated for duty with the hospital and were

sent to New York City, to be equipped for this service.⁶⁸ Base Hospital No. 93 was to have sailed on October 5, 1918, from San Francisco, Calif., and consequently the members of the unit proceeded to San Francisco on the 28th of September.⁶⁹ However, on October 1, 1918, before their arrival, a recommendation was received by the War Department from headquarters, American Expeditionary Forces, Siberia, to the effect that 1 chief nurse with a staff of 25 nurses and 1 dietitian be sent there instead of the base hospital unit originally scheduled for Siberia.⁷⁰ As a result, the 27 women who were selected to proceed sailed from San Francisco as part of Evacuation Hospital No. 17, and arrived in Vladivostock on November 4, 1918.⁷¹

For a few months after their arrival in Siberia the nurses were pleased with the duty there. For quarters they were assigned to Russian barracks, which were fixed over into apartments. The chief nurse in her reports to the superintendent of the Army Nurse Corps was enthusiastic about the way the nurses were adjusting themselves and about the interest they all showed in their work.⁷² However, by the spring of 1919, the morale of the group of nurses was considerably lowered, and many were requesting either discharge or transfer to the United States.⁷² This condition had been foreseen by the chief surgeon, A. E. F., Siberia, because in March of that year he had requested the Surgeon General to change the conventional two years of foreign duty in this instance to one year, the second year to be served in the Philippine Department.⁷³ This request was approved by the Surgeon General in a communication which stated that nurses who had served one year in Siberia might be transferred to the Hawaiian or the Philippine Department for duty, provided vacancies existed at the time in those places.⁷⁴ The last group of Army nurses left Siberia on April 1, 1920, and reported at Manila, P. I., for duty in the Philippine Department.⁷⁵

STATUS

In July, 1917, a paragraph was inserted in Army Regulations which gave to members of the Army Nurse Corps authority in matters pertaining to their professional duties (the care of sick and wounded) in and about military hospitals next after the officers of the Medical Department.⁷⁶ In May, 1919, the above regulation was changed by the omission of the words "pertaining to their professional duties (the care of sick and wounded)."

Regulations in the Manual for the Medical Department previous to 1918 held that the ward master of each ward was directly responsible to the ward surgeon.⁷⁷ He was to be in charge of his ward, and the enlisted assistants and patients in it, and would be obeyed and respected accordingly. Under this arrangement there had been considerable confusion about the relative authority of the head nurse and ward master. Little trouble regarding this matter had existed prior to the Mexican border mobilization in 1916, but with new personnel of all sorts unfamiliarity with Army hospital regulations and customs naturally brought about a certain amount of friction. In March, 1918, an important point was settled when a change in the Manual for the Medical Department placed the full responsibility of ward management upon the head nurse by the ruling that the head nurse of a ward was responsible only to the ward surgeon

and was to be in charge of the ward, the nurses, the enlisted personnel, and other persons assisting in the nursing care of the patients, and of the patients under the direction of the ward surgeon.⁷⁸

THE QUESTION OF RANK

Early in the war, a need of rank for members of the Army Nurse Corps was felt. It was believed that a number of unfortunate occurrences could have been avoided, had nurses been given a definite status. While in many instances regulations regarding rights and privileges, etc., stated that nurses in those regards were to be treated as officers, as, for example, in matters of transportation, it frequently happened, especially in traveling, that because persons in charge of details of transportation did not know the regulations, and also because the facilities for transportation requested were not always forthcoming, under pressure of circumstances, nurses were assigned to transportation accommodations which were neither suitable nor proper. Moreover, to the thousands of new members of the Army there was no indication upon the uniform to show to what class the nurses belonged, and on account of this in many cases they were not accorded the respect commensurate with the dignity and responsibility of their position. Such experiences during the war demonstrated that a different status and a recognition of it would have to be awarded Army nurses in order to interest future desirable nurses in the service and also to retain those already there, but the main argument for rank was the need of a definite status.

During the early part of 1918, the matter of increased pay occupied the more immediate attention of Nurse Corps members than did the question of rank, and while agitation was afoot for the passage of the pay bill, nursing organizations outside the Army brought before Congress a bill conferring relative rank on Army nurses.⁷⁹ This bill was referred both by the Senate and the House of Representatives to the Committee on Military Affairs, but the passage of the bill did not occur until the summer of 1920.⁸⁰

ASSOCIATION OF NURSES WITH ENLISTED MEN

The social association of members of the Army Nurse Corps with the enlisted personnel of the service has always been contrary to the traditions and policy of the Medical Department. The advent of war brought the question to a place of prominence, because, during the World War in the enlisted branches of the military service were to be found men from all walks of life, among whom were included relatives and friends of Army nurses. In many posts remote from towns or cities it was difficult to provide suitable recreation for the nurses, and equally difficult to show a great many of the nurses that a ruling which precluded social relations with enlisted men was for their protection and the good of the corps. This decision had nothing to do with social equality or inequality, but was imperative for the maintenance of military discipline, as, according to regulations referred to above, nurses were to be regarded as having authority in and about military hospitals next after officers of the Medical Department. This authority could not always be asserted when nurses associated with enlisted men. In cases where an enlisted man was a relative or

friend of a nurse, it was possible for the chief nurse to arrange matters in such a way that calls could be made under proper conditions.⁸¹

The policy caused considerable dissatisfaction at times when the few social functions of an Army camp included enlisted men. Civilian women employees not having to have official relations with soldiers were naturally not barred from such association, and at places where recreation was scarce such a ruling worked hardship on that account. In some cases a commanding officer who was particularly anxious about the morale of the enlisted men of his command would have permitted nurses and enlisted men to attend the same social affairs had it not been for the chief nurse's objections.⁸²

A helpful, although not fully satisfactory step, was taken in defining the status of members of the Army Nurse Corps, when on July 31, 1918, a change in Army Regulations included nurses in the list of officers next after cadets.⁸³

PAY

At the time of its establishment by law in 1901 the pay of members of the Army Nurse Corps was \$40 per month and maintenance, and \$50 per month and maintenance when on duty without the limits of the United States.⁸⁴ A chief nurse received \$25 a month in addition to her pay as nurse.⁸⁴ This pay table had been established at a time when graduate nurses in civilian hospitals were receiving \$25 a week for private duty and \$60 and \$65 a month for institutional work as floor nurses. In 1910 the pay was increased to \$50 a month, with \$5 increase for every three years' completed service, for a period of nine years, making the maximum pay \$65 a month after nine years' service.⁸⁵ The act of July 9, 1918, increased the base pay to \$60 per month and maintenance, with \$5 per month increase for each completed three years' service, and an additional \$5 increase after 12 years' service.⁸ This act also provided for \$30 per month additional pay for all chief nurses and \$10 per month extra for foreign service.⁸ At this time nurses in civil life were receiving \$35 and \$40 per week for private duty and at least \$75 a month as a minimum wage for general duty in hospitals. Laundering of uniforms was included. This act also raised the pay of the superintendent of the Army Nurse Corps from \$1,800 per year to \$2,400 per year, and authorized the appointment of not more than six assistant superintendents at an annual rate of \$1,800, and for each army or separate military force beyond the continental limits of the United States one director at \$1,800 per year and not exceeding two assistant directors of nursing service at \$1,500 per year.⁸

PAY WHILE PRISONERS OF WAR

Under date of July 16, 1918, a decision of the Comptroller of the Treasury held that nurses who were reported missing or held as prisoners of war were not entitled to pay during the period of their absence from duty,⁸⁶ but after several protests this decision was modified on September 27, 1918, when the comptroller ruled that if an Army nurse was held as a prisoner of war by the enemy, through no fault on her part, she should be treated as on a full-pay status.⁸⁷ No definite ruling was made regarding nurses who were missing, but, as with officers and enlisted men, each case was to be considered individually upon its own merits according to the evidence obtained.⁸⁷

PAY WHILE ON LEAVE OF ABSENCE

The leave year of a member of the Nurse Corps was to be reckoned in each case from the date of the letter of her appointment.⁸⁸ A leave credit of two and one-half days for each month of completed service, and leave with pay under her appointment was to be allowed, against which was to be charged all absence on leave with pay.⁸⁸ Leave credits were not to be allowed for periods of absence without pay; unused leave credits could accumulate to an aggregate not exceeding 120 days. Leave to the amount of the accumulated unused leave credits were to be granted whenever the exigencies of the service permitted.

PRIVILEGES

ALLOTMENT OF PAY

Before the World War the allotment privilege was not accorded to nurses, but on May 15, 1917, the War Department extended to nurses the benefits of the ordinary Army allotment known as the Class E type.⁸⁹ The first allotments were made in June, 1917, by 56 Army nurses, and payment was made on these allotments in August.⁹⁰

WAR-RISK INSURANCE

On October 6, 1917, members of the Army Nurse Corps were made eligible to compensation for disability or injury incurred in line of duty.⁹¹ This act also provided for Government insurance against permanent disability or death at moderate rates.⁹¹ A large proportion of the members of the corps availed themselves of this privilege.

LAND GRANTS

Service in the Army Nurse Corps for a minimum of 90 days during the World War entitled nurses so serving to a credit on the three-year residence requirement on a homestead for the period of their service up to two years.⁹²

BONUS

Army nurses who reported for duty on or before November 11, 1918, and whose service was honorable, were entitled to the \$60 bonus upon their separation from the service.⁹³

RETIREMENT

Both before and during the World War, nurses, although a part of the Army, were considered as neither enlisted nor commissioned personnel. They were appointed by the Surgeon General with the approval of the Secretary of War.⁸⁴

Just prior to our entering the World War, in 1917, it was foreseen by members of the Nurse Corps that retirement for them after a specified period of service would eventually become an important issue. Therefore, on January 18, 1917, in a memorandum to the Surgeon General, concerning the Army Nurse Corps, the superintendent of the corps set forth her reasons why retirement was such an important measure.⁹⁴ At this time it was proposed that

members of the Army Nurse Corps who had served 16 years in the corps be retired on 51 per cent of the rate of pay that they were receiving at the time of retirement, with an additional 2 per cent for each year of service in excess of 16, but not to exceed 25 per cent of such pay, provided that members of the corps who were incapacitated for service by disability incurred in line of duty be allowed 75 per cent of the rate of pay they were drawing at the time of retirement.⁹⁴ It was proposed further that retirement be compulsory at the age of 55 years.⁹⁴ Though the Army appropriation bill which was sent to Congress in the fall of 1917 provided for increase of pay and for retirement at the expiration of 25 years' service on three-quarters pay,⁹⁵ the clause pertaining to retirement was eliminated before the bill became law.

A later bill, seeking retirement privileges for members of the Army Nurse Corps after 20 years' active service at 75 per cent of their pay at the time of retirement, exclusive of foreign-service pay, was introduced in both Houses of Congress in the summer of 1919.⁹⁶ It passed the Senate but failed to reach the floor of the House before the closing of Congress.^{96 a}

FURLOUGH FARES

Among other privileges, nurses were entitled to furlough-fare rates when traveling on leave of absence.⁹⁷ These rates reduced one-way fares to one-third their ordinary cost and round-trip fares to two-thirds their ordinary cost, and were effective June 10, 1918.⁹⁷

VICTORY MEDAL

As a constituent part of the Army, any Army nurse who served on active duty between April 6, 1917, and November 11, 1918, whose service was honorable, was entitled to the Victory Medal.⁹⁸

UNIFORM

THE INDOOR UNIFORM

An indoor uniform for members of the Army Nurse Corps was adopted in 1899,⁹⁸ since which time details of material and style have been prescribed by the Surgeon General.¹⁰⁰ With modifications of specification in 1910 and 1915, the uniform in September, 1917, consisted of a waist, a skirt, a belt, a collar, a cap, and the badge of the corps, which was a gold caduceus, superimposed in the center by the letters "A. N. C." in white enamel.¹⁰¹

THE OUTDOOR UNIFORM

Previous to the time that the United States entered the World War and particularly before any members of the Army Nurse Corps were sent overseas, there was no prescribed outdoor uniform for the corps. When, however, nurses were ordered to Europe in the spring of 1917, the need for an outdoor uniform was appreciated, not only for reasons of convenience and economy but also for purposes of identification. Therefore, on May 17, 1917, the Surgeon General recommended to the War Department that an outdoor uniform

* The retirement bill became law May 13, 1926.

for nurses, consisting of an olive-drab woolen skirt, coat and overcoat, a hat, a white or olive-drab shirt waist, and tan shoes be adopted.¹⁰² Since the suddenly increased demand for olive-drab materials would have made such a uniform most difficult to obtain, the plan to have this material was discarded, and on May 31, 1917, the blue-serge outdoor uniform of the Army Nurse Corps was adopted.¹⁰³ Part of this outdoor uniform was a dark-blue serge street dress, which after a few months was changed to a dark-blue serge Norfolk suit, with which either white or navy-blue shirt waists were to be worn.¹⁰³ Besides this were the dark-blue overcoat, the hat, tan shoes, and tan gloves.¹⁰³ The caduceus and the letters "U. S." in bronze were to be worn with this uniform, but on May 31, 1917, upon recommendation of the Surgeon General,



FIG. 1.—Nurses' outdoor uniform

the Secretary of War approved the change in the badge by the addition of the letters "A. N. C." superimposed on the caduceus in gilt.¹⁰³ This uniform was to be worn at such times as the Surgeon General might prescribe, and might be worn at any other time when the nurse was not on duty.¹⁰⁴

ATTEMPT TO OBTAIN CLOTHING ALLOWANCE

In August, 1917, legislation was proposed to provide members of the Army Nurse Corps with a suitable clothing allowance, but the Quartermaster General recommended as an alternative that an increase in pay be procured and that nurses be required to furnish their own uniforms.¹⁰⁵ In consequence, the monthly pay of nurses was increased \$10 only,⁸ which proved inadequate in view of the fact that the increase in cost of uniform equipment was proportionately greater.

COMPULSORY WEARING OF THE UNIFORM

The use of the outdoor uniform at all times was not mandatory until after the passage of the pay bill of 1918. Meanwhile, many chief nurses had declared themselves to be in favor of making the wearing of the uniform of the corps compulsory, particularly for the protection of the nurses themselves.

In August, 1918, the Surgeon General informed the commanding officers of all the hospitals where nurses were on duty as to specifications, cap pattern,



FIG. 2.—The American Red Cross cape of dark blue

and other data concerning the indoor and outdoor uniform of the Army Nurse Corps, and directed that all nurses then in the service purchase the suit, hat, and necessary waists within three months.¹⁰⁶ All nurses who entered the service thereafter were to purchase the required garments within three months following their entry.¹⁰⁶ The uniform was to be worn at all times when not on duty in the hospital.¹⁰⁶ The American Red Cross was now to omit from the equipment of nurses ordered overseas the articles mentioned above, but was to continue to issue the other equipment previously given.¹⁰⁶ The American Red Cross cape of dark blue, lined with red, was issued to all nurses on duty in the United States or abroad, and was to be worn with the Nurse Corps insignia and the letters "U. S."¹⁰⁶ Upon the reduction in nursing force, however, brought about by the signing of the armistice, the order

which directed that all nurses purchase the outdoor uniform within three months was revoked.¹⁰⁷

UNIFORM AND EQUIPMENT FOR NURSES GOING OVERSEAS

THE GRAY INDOOR UNIFORM

The nurses attached to the first base hospital units which sailed overseas found the laundry problem there a serious one. On June 29, 1917, the chief nurse of Base Hospital No. 5, which was one of our hospitals on duty with the British Expeditionary Force, France, informed the superintendent of the Army Nurse Corps that the nurses there were finding the white indoor uniforms highly unsuitable, as the hospital was nearly all under canvas tents and the uniform became soiled very quickly.¹⁰⁸ Aprons had been adopted, but they did not solve the difficulty. The only laundry for an area in which were located from 10 to 15 hospitals which had from 1,200 to 1,800 beds each did not include any of the nurses' uniforms, and the personal laundry was done by French peasants in an unsatisfactory manner, due largely to the shortage of water in that region in winter.¹⁰⁸ For these reasons she recommended the adoption of

a uniform, made of such a material as gray crêpe, over which the nurses might wear a white apron.¹⁰⁸ This recommendation and one from the chief nurse of Base Hospital No. 12, dated July 8, 1917, that a dark-blue crêpe uniform to be worn with an apron be authorized for nurses overseas,¹⁰⁹ resulted in authority dated August 9, 1917, for the American Red Cross to provide each overseas nurse in the Army with four medium gray uniforms, to be worn with a white apron.¹¹⁰

INADEQUACY OF EQUIPMENT

The American ambassador at London informed the Secretary of State on July 12, 1917, that the American nurses were in several respects ill equipped.¹¹¹



FIG. 3.—The gray, indoor uniform

Reports were reaching him to the effect that their underclothing was too thin, the white uniform was unsuitable, and they should have been provided with mackintosh, sou'wester hat, and high rubber boots.

MANNER OF OBTAINING EQUIPMENT

Nurses in the meantime were being ordered abroad, and pending congressional action which would provide for equipment the Surgeon General requested the war council of the American Red Cross to make some provision for nurses, both regular and reserve, who were ordered to Europe.¹¹² This the American Red Cross agreed to do at a cost of approximately \$200 per nurse.¹¹³ Previous to this time the uniform had been furnished to reserve nurses by the American Red Cross and had been purchased by regular members of the Army Nurse Corps, although some parts of the equipment had been purchased by both regular and reserve nurses. The articles of equipment which the American Red

Cross furnished to nurses were added to from time to time, and finally included a hat, an outdoor uniform, a coat or heavy ulster, a cape, gloves, two white shirtwaists, two flannel shirtwaists, four gray wash uniforms, six or eight aprons, six sets of collars and cuffs, several caps, two pairs of black woolen "tights," one steamer blanket, one sleeping bag, one gray sweater, one poncho, one blanket roll, one raincoat, one rain hat, one pair rubber boots, one pair of moccasins, three pairs of shoes, six pairs of stockings, heavy underwear, and pajamas.¹¹⁴

GRATUITOUS ISSUE OF CLOTHING

On July 28, 1918, a recommendation was received at War Department from the commanding general A. E. F. to the effect that all nurses whose pay did not exceed \$75 a month should be gratuitously equipped before sailing overseas.¹¹⁵ A decision was rendered by the Judge Advocate General in September, 1918, to the effect that since nurses were a component part of the United States Army, they were as much entitled to a gratuitous issue of clothing as were troops.¹¹⁶ As a result of this decision, War Department, December 17, 1918, directed that members of the Army Nurse Corps were to be issued a single initial outfit upon their first entry into the service.¹¹⁷ This initial outfit was to consist of a navy-blue Norfolk suit, overcoat, flannel waist, velour hat for winter, straw hat for summer, two sets of insignia "U. S.," and two pairs insignia, badge of corps. The following additional articles were authorized for issue in the case of nurses ordered overseas for duty with the American Expeditionary Forces: Six gray cotton uniforms, one gray woolen sweater, one gray woolen muffler, one raincoat, one blanket for use on transport, one sleeping bag, and one trunk locker. This equipment was to be supplied by the Quartermaster Department without cost to nurses who had not already received equipment from the American Red Cross.¹¹⁷ The maroon-lined blue cape was added to the list of equipment in January, 1919.¹¹⁸

The equipment of the first of our nurses who were ordered to Siberia was furnished by the American Red Cross.¹¹⁹ In August, 1919, when 14 additional nurses were under orders for Siberian duty, the Surgeon General requested of and received authority from War Department to equip these nurses with the moleskin coat lined with sheepskin, fur cap, fur gloves, and arctics, usually furnished to troops serving in Alaska and Siberia.¹²⁰

CAMPAIGN BADGES

In 1919 members of the Army Nurse Corps were authorized to wear campaign badges for service not only in the World War but also in previous campaigns, a privilege which hitherto had been granted only to officers and enlisted men.⁹⁷

CHEVRONS

In the summer of 1918 War Department authority was given to members of the Army Nurse Corps to wear wound and service chevrons under the same conditions as were officers, field clerks, and enlisted men.¹²¹ This action was taken in response to a recommendation from the commanding general A. E. F. that the war-service chevron privilege be extended to include members of the Army Nurse Corps.¹²²

VICTORY BUTTON

Nurses who served honorably in the Army Nurse Corps for a minimum of 15 days during the period of the war were entitled to the Victory Button, issued for wear in the lapel of civilian clothes.¹²³

MOBILIZATION AND TRANSPORTATION OVERSEAS

Mobilization as applied to members of the Army Nurse Corps, consisted in assembling the nurse personnel of the units destined for overseas, which were for the most part scattered among several cantonments; equipping these women with uniforms; the preparation of pay accounts, insurance and allotment papers, passports, and identification cards. Upon the Office of the Surgeon General devolved the duty of arranging for suitable mobilization stations and of ordering nurses to such stations, but to the chief nurses of these mobilization centers fell the task of the detailed paper work, keeping track of the large groups of women under their supervision, and the instruction of new chief nurses in regard to Army Regulations, Army customs, and the conduct of all the affairs of these large groups of women who, for the most part, so recently had become a part of the Army Nurse Corps and for whose affairs there naturally existed different business methods. The question alone of the care of the health of these units of nurses was a serious one, not to mention their recreation, conduct, immunization, and general morale.

The first mobilization station for nurses was opened June 15, 1917, with its headquarters at United States Quarantine Hospital, Island No. 3, Ellis Island, New York.⁵ The personnel consisted of one chief nurse, three Army nurses, and three enlisted men of the Medical Department.⁵ This station eventually accommodated approximately 350 nurses.¹²⁴

On September 8, 1917, arrangements were made for the mobilization of 250 nurses, who were awaiting transportation, at United States Army General Hospital No. 1, Williamsbridge, New York City.⁵ This station was considered undesirable for the purpose, because there were no suitable accommodations there for women, a condition which existed until February, 1918.¹²⁵ Consequently, late in September, 1917, when patients began to be admitted in numbers to General Hospital No. 1, the nurses who were mobilizing there were transferred to St. Mary's Hospital, Hoboken, N. J.⁵ Because this latter station in turn proved to be undesirable, on December 17, 1917, the old Colony Club at 120 Madison Avenue, New York City, was opened as a substation to accommodate the overflow of nurses from Ellis Island.⁵ This building housed 130 nurses, who were subsisted at the Martha Washington Hotel.

Since, in the latter part of March, 1918, it proved necessary to use Ellis Island for hospitalization purposes, the nurses who were there awaiting transportation overseas were transferred to United States Army General Hospital No. 9, Lakewood, N. J., until other arrangements could be made.⁵ There they remained until in April, 1918, mobilization headquarters for nurses were established at the Holley Hotel, Washington Square West, New York City.² This was one of a chain of hotels in New York City with which the Government contracted to accommodate nurses who were awaiting transportation overseas. Not long afterwards, the Crescent Athletic Club was utilized for a similar purpose;⁵

and in September, Hotel Albert, on University Place, was made the mobilization headquarters.⁵ This proved much superior to previous places, since it had accommodations for 600 nurses, besides large trunk rooms and greater office space.¹²⁶

The units of nurses which went overseas before any nurses' mobilization stations were in existence, usually accompanied the medical officers of their respective base hospitals, not knowing their destination. They received their orders within the shortest possible period of time before sailing, and received much less personal equipment than the units which sailed later. Subsequently as rapidly as orders could be issued, the nurses of base hospital units destined for overseas were furnished with their necessary travel orders, and with instructions as to taking the oath of allegiance. They then proceeded to whatever station to which they had been directed, there to await transportation.

Days spent at the mobilization stations were full of interest and intense excitement. Every morning each nurse had to be present at roll call, followed by military drill.¹²⁴ After the matter of passports, inoculations, uniform, and equipment had been attended to, there were the rounds of shopping and sight-seeing. It should be noted here, however, that nurses were never allowed to stay away from the mobilization station over night and only for a few hours at a time during the day, because it was never known when sailing orders for a unit might arrive.¹²⁴

In January, 1918, the nurse personnel of one of the base hospital units awaiting transportation at Ellis Island were temporarily distributed among five of the cantonments in order to meet the great need for nurses which existed in those places.⁵ After March, 1918, this practice continued because of the nursing needs in the cantonments and the lack of space for mobilization. Until August, 1918, the procedure in organizing the nursing personnel of base hospital units was to assign nurses to duty as members of particular base hospitals and to keep them attached to their respective hospitals all through their cantonment service as well as after mobilization. On August 12, 1918, the Surgeon General furnished to commanding officers of all hospitals a plan dealing with the selection of nurses for base hospitals abroad.¹²⁷ According to this plan, commanding officers of the various large Army hospitals were to be asked from time to time to submit to the Surgeon General the names of nurses on duty in their respective hospitals who were professionally, physically, and otherwise suitable for overseas service, giving preference to length of service, but omitting those who desired home service only.

In April, 1918, the chief nurse at the nurses' mobilization station, New York City, notified the superintendent of the Army Nurse Corps that she had about 500 nurses on her pay rolls that month.¹²⁸ In May she had over 1,300 on her pay roll. Five hundred and fifty-five of these had been requested by the commander in chief, A. E. F.,¹²⁹ and while in New York they were housed in seven different hotels with no chief nurse attached to the group.¹²⁸

Difficulty was experienced in getting the nurses to understand how much baggage they could take overseas. In spite of instructions to the contrary, some would arrive at the point of mobilization with two or more trunks, several suit cases, and in many cases insufficient funds for their incidental needs.¹²⁸ A

memorandum was issued by the Surgeon General's Office early in January, 1918, which stated that nurses ordered abroad might take with them only a steamer trunk not exceeding 36 inches in length, one suit case or large satchel, and one blanket roll. It also advised each nurse to have if possible \$50 in cash before leaving the United States.¹³⁰

It should be noted here that no member of the Army Nurse Corps, either regular or reserve, was assigned to overseas service against her will.

As early as July, 1917, a school of instruction in conversational French was organized in St. Paul's Chapel, Trinity Parish, New York City, for the benefit of soldiers, sailors, doctors, and nurses. About 4,000 nurses took the course offered. A chaplain of St. Barnabas Guild for nurses was responsible for these arrangements having been made.¹³¹



FIG. 4.—Nurses' rest house, Sunset Hill, Redbank, N. J.

REST HOUSES

Early in 1918, Sunset Hill, Redbank, N. J., the estate of a New York philanthropist, was turned over to the Medical Department for the use of nurses who were in need of rest and recuperation.¹³² A chief nurse was stationed there who managed the place and acted as hostess.¹³² The first nurses to arrive at the Rest House had an idea that they were being sent there as mental cases and were reluctant about accepting its privileges, but once they saw the place, they wished to remain.¹³³ Unfortunately, it was necessary to close Sunset Hill in October, 1918, on account of its inadequate heating facilities, but the following spring it was reopened, and this time it functioned until November, 1919.¹³³ When it was closed in October, 1918, another estate, Greystone, Riverdale on the Hudson, N. Y., was given for the same purpose.¹³⁴ During the period of its use, scores of nurses benefited greatly by its advantages.

DISPOSITION OF NURSES RETURNING FROM OVERSEAS

In March, 1918, the surgeon, Port of Embarkation, Hoboken, N. J., requested of the Surgeon General instructions as to the disposition of nurses who had been returned to the port from overseas, some ill, some desiring discharge, and some who already had resigned.¹³⁵ The Surgeon General directed that such nurses who were ill and also those that had been recommended for discharge be sent to United States Army General Hospital No. 1, New York City, for observation, treatment, or duty, according to the needs of the case.¹³⁶ At the same time, the Surgeon General instructed the chief surgeon, A. E. F., that, when nurses were returned to the United States for any reason, reports in each case setting forth the facts were to be sent on the same boat as the nurse.¹³⁷ Until this had been done, no action could be taken at the ports in the United States and nurses were held at General Hospital No. 1 for long intervals, awaiting the arrival of the necessary information.

DEMOBILIZATION STATIONS

Shortly after the signing of the armistice, 650 nurses who were awaiting transportation were sent overseas,⁵ and then the task of demobilization began with the disposition of the remainder of the 1,445 who were at the mobilization station at that time. By the middle of December, 1918, arrangements had been made with the manager of the Knott chain of hotels in New York City to extend the contract already made to include members of the Army Nurse Corps and civilian women employees who were returning from Europe, as well as those who had been expecting to embark for Europe.¹³⁸ The various demobilization stations for nurses in and around New York City were under the jurisdiction of the surgeon, Port of Embarkation, Hoboken, N. J.;¹³⁸ the nurses who returned via Newport News were under the jurisdiction of the surgeon, Port of Embarkation, Newport News, Va.¹³⁹ As the work of demobilization became heavier and heavier, and hundreds of nurses wished their immediate relief from service upon their return to the United States, blanket authority was given to the surgeons at the ports of embarkation mentioned above to accomplish this purpose.¹⁴⁰ If a nurse was found to be in need of rest or recuperation, she was sent to one of the rest houses for a reasonable period, or if in need of treatment, she was assigned to one of the adjacent hospitals for the necessary care. In the case of nurses who wished to continue in the service, requests were forwarded to War Department, where proper orders were prepared.

CASUALTIES

CONNECTED WITH OVERSEAS TRANSPORTATION

The first war casualties connected with the Army Nurse Corps were two members of Base Hospital Unit No. 12, who were aboard the S. S. *Mongolia*. On May 20, 1917, the day following that of sailing, a gun on deck was discharged during target practice, and, as the result of a faulty shell, three nurses were injured, two of whom died on the following day.¹⁴¹

In July, 1917, the S. S. *Saratoga*, including among its passengers 65 nurses, was accidentally rammed by the S. S. *City of Panama* while still in New York Harbor.¹⁴² The *Saratoga* sank rapidly and the nurses with the others had

barely time to board the lifeboats and small vessels in the harbor, where they remained until proper orders were given for their return to Ellis Island.¹⁴² Since there was no law by which the Government could reequip and reimburse these nurses, the war council of the American Red Cross immediately appropriated a sum sufficient to reequip the nurses and to give each one \$30.¹⁴² One week after this had been accomplished the unit sailed for Europe aboard the S. S. *Finland*.

Of the more than 10,000 nurses who were transported overseas and back the only casualties were in the cases mentioned above.

DEATHS

During the period from April 6, 1917, to November 11, 1918, there were 134 deaths among members of the Army Nurse Corps in the United States.^{143 a} Influenza and pneumonia caused by far the greatest number of these deaths.

Members of the Army Nurse Corps who died during their Army service were buried with military honors. In November, 1918, a plot in Arlington National Cemetery was assigned for the burial of Army nurses, and since that time nurses have been buried there if their families so desired.¹⁴⁴

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- (3) *Ibid*, par. 59.
- (4) *Ibid*, pars. 62 to 67, inclusive.
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- (9) Orders, Surgeon General's Office, September 5, 1918. On file, Record Room, S. G. O., 201 (Aubert, Lillian), 201 (Rutley, Edith H.), 201 (Kershaw, Edith A.).
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- (23) Correspondence filed, Record Room, S. G. O., 622 (Camp Grant, Ill.).
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CHAPTER II

AMERICAN NURSES WITH THE BRITISH EXPEDITIONARY FORCE, FRANCE

PLAN FOR SUPPLYING PERSONNEL

In April, 1917, after the arrival of the British mission in Washington, the needs of the British Army, in so far as medical assistance was concerned, were made known to us.¹ For service with the British Expeditionary Force in France the British mission asked the United States for medical personnel, including doctors, nurses, and enlisted men, together with the equipment and supplies for a certain number of hospitals.¹ Accordingly, the War Department called upon the American Red Cross to mobilize six base hospitals for immediate shipment to France to serve with the British Expeditionary Force there.² These constituted the first organized forces of the United States to be sent to France, and they sailed between May 8 and 24, 1917.³

In accordance with the plan of the British mission, 200 medical officers and 200 nurses were to be dispatched, in addition to the six base hospitals, for service with the British Army during each of the months of June, July, and August, 1917.¹ It was stipulated in the plan referred to that at least half of this personnel should be regarded as lent to the British Army only until the arrival in Europe of combat troops from the United States, at which time the American Army should be assured of the services of a minimum of 300 of our medical officers and 300 nurses who, meanwhile, had become familiarized with the local conditions in the war area.¹

THE FIRST SIX UNITS

Within six months after the United States had entered the war, approximately 1,100 nurses had sailed overseas, about half of whom were stationed in six British general hospitals.⁴ The first base hospital units to sail took over British general hospitals as follows, shortly after their arrival in France:³ Base Hospital No. 4 (Lakeside Hospital Unit, Cleveland, Ohio) sailed May 7, 1917, reported for duty May 25, 1917, and took over No. 9 British General Hospital, Rouen; Base Hospital No. 5 (Harvard University unit, Boston, Mass.), sailed May 11, 1917, reported for duty May 30, 1917, and took over No. 11 British General Hospital and later No. 13 British General Hospital, Bologne; Base Hospital No. 2 (Presbyterian Hospital unit, New York, N. Y.), sailed May 12, 1917, reported for duty June 2, 1917, and took over No. 1 British General Hospital, Etretat; Base Hospital No. 21 (Washington University Medical School unit, St. Louis, Mo.), sailed May 19, 1917, reported for duty June 10, 1917, and took over No. 12 British General Hospital, Rouen; Base Hospital No. 10 (Pennsylvania Hospital unit, Philadelphia, Pa.), sailed May 19, 1917, reported for duty June 12, 1917, and took over No. 16 British General Hospital, Le Treport; Base Hospital No. 12 (Northwestern University Medical School unit, Chicago, Ill.), sailed May 24, 1917, reported for duty June 11, 1917, and took over No. 18 British General Hospital, Dannes-Cammiers.

NURSING CONDITIONS IN FRANCE, WITH THE BRITISH EXPEDITIONARY FORCES

The hospitals taken over by the American units had been functioning actively for three years, and from the beginning of that period had seldom less than 900 or 1,000 patients, and very frequently more than that number in each. The British authorities made arrangements for each of the units to be met and conducted to the hospital which it was to take over. The British matron and a few of the nursing staff (assistant matron, home sister, night sister, etc.) remained for a certain length of time to assist the American staff in becoming acquainted with the ways of British hospitals. The British nursing staffs, members of Queen Alexandra's Imperial Military Nursing Service, were withdrawn from the hospitals almost as soon as the American nurses arrived, and as the American units contained considerably fewer nurses than had the British staffs it became necessary for them to secure additional nurses from some source until more could arrive from the United States. A statement of the nursing requirements of each unit was submitted, and as a result their numbers were supplemented by members of the voluntary aid detachment, which was made up of British volunteer aides—young women, many of whom had had considerable experience in one or more phases of nursing activity. In a number of cases members of the voluntary aid detachment were allowed to remain to serve with the American nurses, because without them there would have been inadequate staffs for the hospitals, but upon the arrival of supplementary units of American nurses six months later, these "V. A. D.'s," as they were called, were withdrawn and distributed by the matron in chief to other British units which were manned exclusively by British personnel.⁵

MATRON IN CHIEF AND PRINCIPAL MATRONS

The matron in chief of the British Expeditionary Force in France kept herself in close telephonic communication with all the British hospitals and the headquarters of the different armies there.⁶ In each active area was a principal matron who represented the matron in chief in handling all nursing affairs in that area. Frequently these principal matrons served in the capacity of matron or chief nurse of a hospital as well as a principal matron of the area. Chief nurses of the American Army served as matrons of their respective hospitals when the British nurses were withdrawn. Questions of leave, transfer, sickness or discipline were referred by the matron to the principal matron, and she either took action or, when necessary, passed the questions on to the matron in chief.⁶

INSPECTION TRIPS, BRITISH MATRON IN CHIEF

Very often the matron in chief made unexpected inspections, at which times the matrons and commanding officers were interviewed, both separately and together. By detailed questions concerning all phases of the nursing situation, the matron in chief kept herself informed of the actual conditions and also kept the nurses assured of the interest of British headquarters in their welfare.⁶ While making inspections, she made especial effort to talk with every nurse she met, and thereby to discern the attitude of individual members of the staffs.⁶ On almost all of her visits she was accompanied by a secretary, who took notes of every conversation.

DISTRIBUTION AND DUTIES OF AMERICAN NURSES

Supplementary to the nurses on duty with the six base hospitals, in February, 1918, a group of 99 nurses, designated Casual Group A, arrived in France, and they were distributed among British general hospitals in the Rouen area.⁵ A second group, Casual Group B, composed of 87 nurses, reported in France in July, 1918, and these nurses were distributed in different areas, according to the requirements.⁵ Shortly afterwards mobile units of 20 nurses each were organized from several of the original base hospital groups, and it became necessary to replace the personnel withdrawn from the base hospitals with members of the casual groups which were then serving in British hospitals.

Operating teams were sent to casualty clearing stations near the front lines, and each team was composed of two medical officers, a nurse, two orderlies, and an officers' batman.⁷ Only the most competent and dependable nurses were detailed to duty with teams, or with the mobile units which served in the forward areas at British casualty clearing stations.⁶ From time to time selected groups of nurses were drilled in the wearing and use of gas masks, and when an order was received for nurses to go on a surgical team, nurses with such experience were chosen. Sometimes they would remain away on a surgical team only a few days, and sometimes several weeks. Duty at casualty clearing stations was performed in the midst of air raids for many hours at a time, but despite the danger connected with such service, only three members of the Army Nurse Corps were wounded by enemy action.⁶

The American nurses who served in casualty clearing stations on surgical teams had most worth while and interesting experiences. In no case did any of them endure such hardships as were undergone by English sisters, many of whom served for months at the front, frequently under fire, and often retreating or advancing, as the German lines pushed forward or withdrew. There were, however, a few American nurses who experienced the condition of real warfare for short periods; a few were with casualty clearing hospitals which were obliged to retreat.

BRITISH ORGANIZATION AND METHODS

"PAPER WORK"

The American nurses adapted themselves very quickly to the British methods, although at first there was inevitable confusion in regard to certain details, most of which, after a short time, became adjusted and facilitated by patience and courtesy on both the British and American sides.⁶ Chief nurses who served with the British Expeditionary Force in France found it necessary to accustom themselves to British "paper work," which was strange to them, and they had also the question of foreign currency to deal with. The salaries of the American nurses were paid by the American Army and could easily be figured in dollars and cents. The agreement with the British Army, however, was that the nurses' maintenance allowance should be paid by British.⁵ The mess allowance for each nurse was 25 shillings a month, the laundry allowance 6 shillings a week, and the field allowance still another amount; and since it was necessary to prepare the pay roll each month for all of these sums for 100 women, with proper deductions for days in sick sisters' hostels or hospitals,

or on leave, it can readily be seen that these chief nurses were obliged to become very proficient in English currency. Since these nurses were in France, their pay checks were made out in francs, which did not add to the simplicity of the accounting system.

COURSE IN ANESTHESIA

A number of American nurses stationed with the British Expeditionary Force were given the opportunity to take a special course in anesthesia. At Rouen, where the Cleveland (Ohio) unit (Base Hospital No. 4) was stationed, there were especially good facilities for giving such a course.⁵

LIVING CONDITIONS

QUARTERS

The quarters occupied by the nurses with the British Expeditionary Force in France were long, single-storied huts, divided by partitions into small compartments or cubicles, each of which had an electric light.⁶ Heat was furnished by oil or coal stoves. The British Army provided its own nurses with camp kits, each of which contained a portable camp bedstead with bag, a pillow, a waterproof sheet, a tripod washstand with canvas basin, bath, and bag, a folding chair, a waterproof bucket, and a kit bag to hold all of these articles.⁶ With such equipment a British nurse was able to occupy otherwise unfurnished quarters and be reasonably comfortable. The first American nurses to arrive in France with the United States Army had no such equipment, and when the British nurses were withdrawn from the hospitals the American nurses faced quarters which had no furniture.⁶ The London chapter of the American Red Cross immediately came to the rescue and furnished the necessary articles until the United States Army took steps to remedy the condition.⁶ For a time camp kits were supplied, but in June, 1918, the question again arose when the director of the Red Cross bureau of nursing in Paris wrote to the director of the department of nursing, American Red Cross, in Washington, stating that many of the nurses who had been sent over had been given this equipment, but that the order authorizing such action had been countermanded.⁸ Upon inquiry, the superintendent of the Army Nurse Corps learned that the Medical Department of the Army was prepared to furnish the articles included in the "camp kits," and she accordingly made request on July 22, 1918, that 100 sets of the desired articles be sent to the medical supply depot in England for issue to American nurses who were detailed for duty with the British forces, and that when such supply was exhausted a further supply be obtained.⁹

FOOD

The food was sufficient, though it seemed odd to breakfast on tea, bread, and cold ham; but gradually the chief nurses learned how to adjust the menus and, by collecting from each nurse a little extra money (in francs) for the mess fund, to provide the articles to which the nurses had been accustomed.¹⁰ The American nurses failed to appreciate the recurrence of custard and canned fruit for dessert, and the presence of the volunteer aid detachments, who were satisfied with the British food, did not make the problem of food any easier. It should be added that there was never any lack of jam or preserves, and that on the whole the food was palatable and nourishing.

LAUNDRY

Laundry presented the greatest problem. With most of the hospitals under tents, it was impossible to keep white uniforms in wearable condition.⁶ Laundries adjacent to the hospitals sometimes attended to the hospital laundry, but personal laundry and nurses' uniforms were not often so included. French peasants in the vicinity could be employed to wash, but their work was not entirely satisfactory; in some cases the laundry was done in convents.⁶ No starch was available; and, as winter advanced, the water supply, already scarce, became scarcer. Partial solutions to the problem of the uniform were found in the authorization of the gray indoor uniform and the so-called "butcher's apron."⁶



FIG. 5.—"Butcher's apron" to protect the uniform

RECREATION

Forms of recreation were few. The habit of making tea a regular function was in many ways desirable. It furnished opportunities for a few minutes' rest and relaxation which undoubtedly added greatly to the powers of endurance of the nurses during the long periods of very hard work. Concert parties were one source of interest and amusement, and in a very short time the Americans developed baseball teams and improvised tennis courts; but long walks and picnics were the usual form of recreation. The question of dances was a very serious one with the units attached to the British hospitals, because British sisters^a were not allowed to have them.⁶ The Americans, however, found that

^a The British nurses are all called "sisters." Sisters are in charge of wards; nurses are less experienced.

this was one of the most desirable forms of social affairs for both nurses and officers, and wherever it was possible to hold a dance without offense to the British or the French this proved an excellent diversion.⁶

CARE OF SICK NURSES

According to British regulations, when a nurse became ill in a British Expeditionary Force hospital she was allowed to remain in quarters no longer than 24 hours.⁶ At the end of that time, if she had not improved, she was transferred to a sick sisters' hostel or hospital, an institution maintained for the care of sick women in many British Army areas. These hostels had their own staffs of medical men and sisters. Every possible comfort and attention was given the sick, and as they were always situated amid beautiful surroundings conditions were most conducive to rest and recovery.⁶

LEAVES OF ABSENCE

British sisters were granted leaves of absence at regular intervals, and while on leave were permitted to go only to specified places, which were designated as leave areas, where traveling and hotel accommodations for these were arranged for.⁶ This system differed from the American system, which permitted nurses to go on their leaves almost wherever they chose to go, although many times they were forced to travel without the proper facilities and to run the risk of not being able to secure hotel accommodations.⁶ The British system had been worked out after many months of experience and seemed to offer a solution to many of the problems incident to the presence of unchaperoned women in areas which were filled with thousands of soldiers and officers convalescent or on leave. Moreover, by having special leave areas it was possible to arrange for special trains for sisters on leave and to secure every comfort for them in especially designated hotels or pensions.⁶

CASUALTIES

On the night of August 17, 1917, during a German air raid, a member of the Army Nurse Corps attached to Base Hospital No. 2, on duty at Casualty Clearing Station No. 61, was struck by a piece of shrapnel, thus necessitating the removal of one eye.⁶ A second nurse during the night of September 4, 1917, while serving with Base Hospital No. 5, received a shrapnel wound in the face, but it was so slight that she did not have to be relieved from duty.⁶ The third nurse, who was attached to Base Hospital No. 10, had been sent with a team to a casualty clearing station, which the Germans bombed. When this occurred, the group retreated to Amiens, near where they had been located, but the raids were in progress here as well. The nurse referred to was wounded in the leg by shrapnel in March, 1918, and did not return to duty until the latter part of July, 1918.⁶

DEATHS

Up to the time of the signing of the armistice four members of the Army Nurse Corps who were attached to the first six units that proceeded to France died while in the service, in addition to the two members of Base Hospital No. 12, who died as the result of an accident on the S. S. *Mongolia*.^{6 b}

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CHAPTER III

RELATIONSHIP OF AMERICAN RED CROSS HEADQUARTERS IN PARIS AND ARMY NURSE CORPS

BUREAU OF NURSING

The Paris Bureau of Nursing of the American Red Cross was instituted in the summer of 1917, after the arrival there of two American Red Cross nurses, who reported at the headquarters of the Red Cross Commission in France, the one with orders to be chief nurse of the American Red Cross in France and the other to be director of the children's bureau in Paris.¹

In assuming her duties the chief nurse had her own pathway to hew, since the adventure was an unprecedented one. One of the first things she did was to attempt to secure for the American Red Cross the services, as nurses, of all American nurses who were at that time independently in France or in England.¹ Then, with the view of establishing a closer relationship between the American Red Cross in France and the Army Nurse Corps there, so that the American Red Cross could at all times be in a better position to know such needs of the Army nurses as could be fulfilled by the Red Cross, the chief nurse of that organization, in October, 1917, initiated arrangements for a conference of Army chief nurses.¹ Fifteen nurses attended the conference, which was held in Paris at the time referred to. Among other things, questions of housing for nurses, their uniform, nurses' aides, diet kitchens in hospitals, the care of sick and convalescent nurses, and pay were included in the problems in which the Red Cross was asked to lend its assistance.¹

In April, 1918, an Army reserve nurse who had been chief nurse of Base Hospital No. 21 for a year was ordered, at the request of the American Red Cross Commission in France, to the Paris office and was assigned to duty as chief nurse of the American Red Cross in France.¹ This appointment took place just as the former Red Cross chief nurse departed for the United States. Her duties were the supervision and control of all activities which might be assigned by the Army to the Red Cross, which included assistance to nurses, both on leave and under orders to return to the United States, the supply of American Red Cross equipment, and the establishment and control of a bureau of American Red Cross nurses who were in the Army. It was also planned to enlarge the activities by the establishment of an authoritative information bureau for nurses and also of a Red Cross nurses' aide service for France.²

Soon after the chief nurse of the American Red Cross began her duties as such, the work of the nursing bureau became almost entirely an emergency service for the sick and wounded of the American Expeditionary Forces. Groups of Red Cross nurses and nurses' aides had been assigned to headquarters of the American Red Cross Commission in Paris for work in connection with the civilian population, and in April, 1918, there were 800 of these women on duty in France with the Red Cross.¹ At about this time many American

Red Cross nurses who had been sent to Europe at their own request for other than Army work in France requested and received assignment to active service in the Army Nurse Corps.¹

Having an Army nurse in the position of chief nurse of the American Red Cross was especially desirable, not only because a closer cooperation concerning problems of the Army nurses between the Army and the American Red Cross could be effected but also because it frequently was possible for the Red Cross nursing bureau to supply nurses at places where they were badly needed by the Army during emergencies.

Among other institutions which the Red Cross had established for the service of the French was the "American Ambulance" in Paris. This was turned over to the American Expeditionary Forces on July 20, 1917, and was designated American Red Cross Military Hospital No. 1, though it continued at first to receive only French casualties.³ As General Pershing would not permit American military hospitals in Paris at that time,⁴ and hospital facilities were needed there, the American Red Cross then established a number of hospitals whose collective capacity was rapidly increased to 10,000 beds.⁵ The association also established other hospitals in the field, where they operated as evacuation hospitals in the rear of the various divisions. These Red Cross hospitals were used in the zone of the armies only through urgent necessity; they were organized at the request of the chief surgeon, A. E. F. Personnel for them came largely from the Army, but their equipment was supplied by the Red Cross. The nursing personnel for these hospitals was made up in all instances as a result of emergency methods and comprised both American Red Cross nurses and members of the Army Nurse Corps.⁶

To facilitate supplying adequate nurse personnel to these hospitals, a special meeting was held at the office of the general manager of the Red Cross in Paris on May 29, 1918.⁷ After discussion of the need for nurses to take care of American soldiers not only in Paris but in hospitals nearer the front, it was determined that the Red Cross department of civil affairs should call in at least 40 nurses and put them into the hands of the chief nurse of the American Red Cross in France for reassignment under the Red Cross department of military affairs. Later this number was changed to 60. In addition it was possible for the chief nurse of the American Red Cross, because of her connection with the Army, to secure the loan of 50 Army nurses whom it was possible to transfer to the hospitals referred to above much more easily than Red Cross nurses.⁸ Information that nurses were available was sent out to the hospitals and, as was expected, urgent calls came for them and they were sent away in groups of 10 or 15 with often not more than an hour's notice to meet emergencies in front-line hospitals. These nurses who formed a reserve force were housed temporarily in a hotel in Paris, and were divided into groups, the head nurse of each of which had to report at Red Cross headquarters every two hours.

The following experience gives a good picture of the way that Red Cross military hospitals were supplied with nurses throughout the summer months of 1918:⁹ When the first of such nurses were called from their civilian activities and within a few hours' notice were placed in trucks and conducted in person by the chief nurse to the American Red Cross Military Hospital, Beauvais, inquiry

was made on the way regarding the special experiences of these 20 nurses which would fit them for the work ahead of them in an improvised military hospital. Lists were made of those who would be best fitted for operating-room work and executive positions, etc., but when the group arrived in utter darkness during a raid by airplanes they were told as they were hurried from the trucks to the comparative safety of the building that eight of them were needed immediately for night duty. The entire group volunteered, although they had been traveling for hours and were very much fatigued. Because of the impossibility of having a light by the aid of which lists of qualifications could be consulted, the choice was made by taking the first eight who could be touched, as they happened to stand nearest the door. Since they all were Red Cross nurses, they were all fitted for any kind of work in the hospital, and they soon forgot that they were baby specialists or public-health workers in the crowded surgical hours that were ahead of them.⁹ When members of the Army Nurse Corps were available, they were added to groups already functioning in these hurriedly improvised hospitals.

The fact that these emergency detachments were authorized to move on French military papers obtained by the Red Cross added greatly to the efficiency of this service; moving them on authority obtained through our Army channels would have caused greater delay. When emergency calls for nurses were urgent and the distance not too great, nurses were sent in camionettes, as in all cases the saving of time was considered a most important factor.¹⁰ Later, because of the necessity of individual identification cards and orders for all persons not in the Army proper, the chief nurse was able to move emergency detachments of nurses on Army orders with great saving of time.¹

In order that administration might be simplified, the Red Cross personnel of these hospitals were made part of the Military Establishment as soon as possible. The chief nurse was made a member of the Army Nurse Corps, and the opportunity was given to members of her staff who were not already in the corps to take the oath of office as reserve nurses.¹ There were some nurses who did not wish to transfer to the Army, and they continued to be paid by the American Red Cross. At the time that the military situation demanded that all these Red Cross nurses occupied in civilian work be sent to hospitals filled with wounded men it was not known in the office of the Red Cross in Paris that these nurses had been sent to France under the Red Cross with the distinct understanding that they were to be employed in civilian work only. It was learned later that this arrangement had been made because of the refusal on the part of many of these nurses to enter the Army Nurse Corps in the United States for fear they would be sent to military posts in the United States for periods of service before transfer to the American Expeditionary Forces.¹ The office in Paris had no means of knowing this fact or of the institution of this policy on the part of the American Red Cross in Washington, but even if it had been known it is not probable that any other action could have been taken than that which was taken when these nurses were called from their civilian work and placed upon active duty with the Army.

A number of the hospitals which were established by the American Red Cross, as outlined above, had been functioning for many months as civilian

hospitals, having American and English nurses on their staffs. When it was necessary because of the military situation to transform these hospitals into military hospitals and to reorganize the personnel into a military one, it was almost invariably the rule that all of the nursing personnel wished to remain as part of the nursing personnel of the newly formed organization. In so transforming the nursing personnel it became essential sometimes, in order to meet an emergent situation, to waive the ordinary requirements not only for enrollment in the Red Cross nursing service but also for assignment to duty as reserve nurses of the Army Nurse Corps. In this way nurses who would not under ordinary circumstances be eligible were sworn in as members of the staff under a chief nurse, functioning as a chief nurse of the Army Nurse Corps, paid by the Army and controlled by the Army. In most instances such nurses requested relief from active service after the termination of hostilities and became separated from the corps in France.¹ As stated above, the magnitude and uncertainties of the task ahead were sensed early, and it seemed very desirable to assign to the Red Cross certain appropriations for emergencies while the Army Medical Corps was building a large program of permanent hospitalization. In this plan of appropriation the freedom of the chief nurse, American Red Cross, who at the same time was a chief nurse of the Army Nurse Corps and thus functioned in a dual capacity, made it possible for her to meet emergencies with both American Red Cross and Army Nurse Corps personnel in a way that prevented loss of time and duplication of effort.¹

Inspection trips were made by the chief nurse, American Red Cross, who was thus better enabled to make plans for her work and to see at first hand the conditions under which the nurses were living and working.¹

Shortly before the signing of the armistice, the chief nurse was ordered to the office of the chief surgeon, A. E. F., to become the director of the nursing service, A. E. F. She was succeeded by the Army nurse who had formerly been the chief nurse of Base Hospital No. 5, who for a number of months had been her assistant at Red Cross headquarters in Paris.¹

AMERICAN RED CROSS EQUIPMENT BUREAU

Within a very few months after the arrival of the American nurses in France it was found that there were great discrepancies in their equipment and also that many of their needs could be supplied from local sources. The nursing bureau of the American Red Cross in Paris undertook to deal with this difficulty and all requests for nurses' equipment were referred to them. It is not surprising that certain problems presented themselves in this project. In the first place it was most difficult for local firms to obtain the necessary labor and materials, and then, too, even when these were procurable, frequently the railroad companies refused to carry the materials because of the quantities of military supplies to be shipped. In the summer of 1918 a nurse who had reported at American Red Cross headquarters in Paris was assigned to duty as an Army reserve nurse and put in charge of the question of equipment. She organized the equipment bureau, taking up the work at a time when notification had been given that in the near future equipment would be needed for 10,000 nurses, including the nursing staffs of 40 mobile hospitals. This

necessitated a great increase in contracts as well as an enlargement of the equipment bureau quarters. To these new quarters came from 50 to 100 nurses daily for various articles of clothing; many came for their own personal equipment but many others came with large orders for their hospitals. Such articles as trench coats and hats, jersey uniforms, rubber aprons, rain hats, rubber boots, sweaters, mittens and wristlets, woolen underwear, tights, eating utensils, cot pillows, mattresses and cots, rubber sheets, blankets, bedding rolls, bed socks, wash cloths, hand towels, and duffle bags were issued to those who needed them.¹¹

By the spring of 1919 the equipment bureau had made purchases of equipment which amounted to 3,000,000 francs.⁴ The nurse in charge of this bureau frequently found it necessary to make delivery of supplies in all sorts of extraordinary ways. It was no unusual occurrence for a medical officer who had come to Paris on leave and who had visited the American Red Cross headquarters there to be asked to carry some supplies back to his hospital. In other cases the nurse in charge of the equipment bureau went by motor, not only to deliver supplies but also to find out from various mobile medical units, which never remained long in the same place, what their needs were, and often she had with her sufficient supplies to furnish them with the needed articles on the spot. On these trips she frequently carried supplies to as many as 300 nurses who needed equipment for various reasons. Some were on temporary duty away from their proper stations; others' trunks had been lost en route from the United States, or, as happened to a small group of nurses, their equipment had been burned.¹²

By the time notification was received that the Army would supply nurses' equipment the Red Cross equipment bureau was utilizing the services of 10 persons in an efficient manner. A cash-sales department for extra equipment was functioning, as well as a trucking service. When information was received that the Government would handle nurses' equipment, it was necessary to cancel many contracts which had been made by the American Red Cross and no longer to supply nurses with the articles which could be obtained through the Quartermaster Department of the Army.¹¹

REST AND CONVALESCENT HOMES

The maintenance of rest and convalescent homes was one of the important lines of work of the Red Cross nursing bureau, and its cooperation in providing these facilities for members of the Army Nurse Corps was of value to the corps.¹¹ Because of her close association with the work of the chief nurses at Red Cross headquarters, the director of the women's bureau of hospital service was able to be of great assistance in this matter as well as in many other activities of the nursing services.¹¹

Two convalescent homes were maintained by the American Red Cross—one at Le Croisic, near St. Nazaire, and one at Cap d'Antibes, near Cannes.¹¹ The convalescent house at Le Croisic was a hotel on the Brittany coast where guests might stay for 10 francs a day. It was designated American Red Cross Convalescent Home No. 6, and was open from July to November, 1918. It offered accommodations for 100 women—either nurses or civilian workers—

who were on leave or convalescing. The home at Cap d'Antibes, designated American Red Cross Convalescent Home No. 11, functioned from January 6, 1919, to May 10, 1919, and accepted Army, Navy, and Red Cross nurses and American women civilian personnel who were on sick or convalescent leave. Two hundred women could be housed in this hotel.¹¹

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CHAPTER IV

IN THE AMERICAN EXPEDITIONARY FORCES

ORGANIZATION

CHIEF NURSE

Until November 13, 1917, there was no representative of the Army Nurse Corps either in the office of the chief surgeon, A. E. F., or in that of the surgeon, line of communications. At that time, however, in response to a cablegram request of October 2, 1917, from the commander in chief, A. E. F., for a competent member of the Nurse Corps to be sent to France to act as superintendent of nurses, A. E. F., a chief nurse reported to take charge of nursing affairs.¹ Another member of the Nurse Corps had accompanied her from the United States to act as her assistant.

OFFICE OF THE CHIEF NURSE

The office of the chief nurse, A. E. F., was established in the surgeon's office, line of communications, rather than in the office of the chief surgeon, A. E. F., since, at the time in question, the administrative jurisdiction of all base hospitals in the American Expeditionary Forces was in the office of the surgeon, line of communications, and it was not intended that nurses would serve in any other type of hospital, more especially in hospitals that would be located in the zone of the advance.¹

In the office of the surgeon, line of communications, the office of the chief nurse, A. E. F., became a part of the personnel division. Here, the chief nurse, with, for the most part, the one assistant mentioned above, functioned until the office of the surgeon, line of communications, was merged with the office of the chief surgeon, A. E. F., in Tours in March, 1918. Subsequently, the chief nurse was a part of the personnel division of the latter office.¹

The greater part of the time of the chief nurse was taken up with administrative duties.¹ These duties, however, did not include the assignment of nurse personnel, both original and by transfer, for such assignments were made by the officer in charge of the personnel division, a practice which had obtained prior to the arrival of the chief nurse in the American Expeditionary Forces.¹ Because of this manner of handling the nurse personnel, the chief nurse, A. E. F., in order to keep herself informed as to the changes among the personnel, and to have a record in her own office of where each nurse was located, was obliged to depend upon the daily reports which were sent in from the various hospitals.¹ Thus there was at hand a means of checking the monthly returns of nurses, which also were rendered from hospitals.¹

In addition to such routine work as that referred to above, there was at all times a great deal of correspondence between the chief nurse, A. E. F., and the chief nurses of hospitals.¹ This correspondence had to do with interpre-

tation of regulations and other instructions concerning the Nurse Corps, made necessary by reason of the fact that most of the chief nurses of the hospital units were relatively inexperienced in such matters.¹

Because practically all of her time was devoted to administrative matters, the chief nurse found few opportunities for inspecting local nursing conditions; however, from time to time such inspections were made by her.¹

DIRECTOR AND ASSISTANT DIRECTORS

On July 9, 1918, Congress authorized the appointment of one director and two assistant directors of the nursing service, A. E. F., in France.² The same quota was authorized for Base Section No. 3, England. However, no appointments were made under this allowance until November 2, 1918, when the original chief nurse of Base Hospital No. 21, who had been assigned to duty as the chief nurse of the American Red Cross in Paris, was appointed to the position of director of nursing service, A. E. F.³ She reported to the chief surgeon for duty on November 15, 1918, and on December 2, 1918, the former chief nurse, A. E. F., returned to Washington to become an assistant superintendent of the Army Nurse Corps.³ The chief nurse of Base Section No. 3, England, received an appointment as assistant director of nursing service, A. E. F., on November 18, 1918, and the former assistant to the chief nurse, A. E. F., became an assistant director on December 14, 1918.³

INSPECTION TRIPS

In so far as the nursing service was concerned, the director of nursing service, A. E. F., emphasized the importance of the connection between the chief surgeon's office, A. E. F., and the hospitals, and affected a closer relationship by means of constant inspection trips to the various hospital centers and also to hospitals operating separately.³ These inspections were made from the point of view of the comfort and welfare of the nurses, as well as of their efficiency, and a complete inspection included conferences with the commanding officer and chief nurse of each organization, both separately and together, with opportunity for frank discussion of problems. Close inquiry was made in all cases into the matter of quarters, food, recreation, and all other living conditions, and especial attention was paid to the problems of sick nurses. On these trips occasions always were made to discuss nurses who presented particular problems to the chief nurses, but about whom it had not been considered advisable to send in official derogatory reports. When such cases were found, efforts were made to relieve the situation, and in many instances the transfer of such individuals was all that was necessary. Generally the director of nursing service included as a feature of her inspection trips talks to as large groups of nurses as possible, and in these talks she would call their attention to the importance of maintaining the proper standards of conduct and of continuing to observe the usual peace-time conventions instead of permitting thoughtless but dangerous relaxation. They were told of conditions in other units, and in every instance they were told of the interest of the chief surgeon, A. E. F., in their well-being. The nurses were given an opportunity to declare themselves in the matter of abstinence from alcoholic liquors, and whenever a vote was taken most gratifying

affirmative results were obtained.⁴ Every nurse who wished to talk privately to the director was given the opportunity to do so, and frequently such interviews extended late into the night.⁵ In many instances groups of as many as from five to eight hundred nurses were addressed. Such instances occurred at the large hospital centers where there were sometimes as many as 10 hospitals comprising the center.³

Between the time of her appointment in November, 1918, and her return to the United States in June, 1919, two-thirds of the director's time was spent in traveling among the hospitals. Aided in a few cases by two of her assistants, she visited nearly 100 hospitals or stations where nurses were present in the American Expeditionary Forces.⁶

DISTRIBUTION OF NURSES

The original plan for an American Red Cross base hospital provided for 50 nurses and 25 nurses' aides.⁷ However, when the first base hospitals were sent overseas a ruling was made by War Department that aides could not accompany them, thus causing the number of nurses to be increased to 65.⁸ Upon arrival of the first six of these hospitals at their destinations early in 1917, this number was found to be inadequate, as these nurses replaced British staffs of more than that number;⁹ therefore steps were taken to raise it to 100 nurses.

In the first six months after America entered the war there were approximately 1,100 nurses in the American Expeditionary Forces, about half of whom were stationed in six British general hospitals.³ Subsequent to this time more nurses arrived, but in insufficient numbers; so, to prevent a serious shortage, on May 3, 1918, the commander in chief A. E. F. requested the War Department for 555 additional nurses.³ This need was met as soon as transportation facilities could be provided. During the month of September, 1918, over 1,300 nurses arrived in the American Expeditionary Forces.³

Base hospitals which were numbered from 50 to 100 were organized by the Army, and each hospital included 100 nurses. Those which were numbered above 100, with the exception of Base Hospital No. 102, the Italian unit; Base Hospital No. 114; the orthopedic unit; Base Hospital No. 115, the head surgery unit; Base Hospital No. 116, the fracture unit; and Base Hospital No. 117, the psychiatric unit, were organized in the American Expeditionary Forces, and their nursing staffs were taken from the larger groups already in operation.³

HOSPITAL CENTERS

No attempt is made here to go into the organization of hospital centers,^a except to state that a hospital center comprised a group of base hospitals, each of which had its quota of nursing personnel assigned in the same manner as in the case of an isolated base hospital.

Until shortly after the signing of the armistice there was no local member of the Nurse Corps who had supervisory control over all the nurses at one center. In order that the director of nursing service might keep more closely informed as to the nurses and their living and working conditions the plan was adopted of assigning center chief nurses to 11 of the large hospital centers.³ These

^a Consult Volume II, Administration, American Expeditionary Forces, for details concerning hospital centers.

center chief nurses were regarded as assistants to the director. According to the plan of the director of nursing service, A. E. F., the duties of a center chief nurse were to be as follows:³

1. To assist the commanding officer of a center in such matters pertaining to the nurses of the center as he may see fit to assign to her.

2. To assist in the distribution and readjustment of nurses within the center, according to the pressure of work in the various hospitals.

3. To keep informed by frequent visits of the conditions in the hospitals of the center as they affect the nursing personnel, such as quarters, the mess, means of recreation, care of sick nurses, etc.

4. To bring to the attention of the director of nursing service, after consultation with the commanding officer of the center, any matters which seem to need especial adjustment.

5. To act as chairman of a committee of chief nurses of the center. This committee will make suggestions for regulations governing the conduct and social relations of nurses, which shall be, as far as possible, uniform for the entire center. These suggestions should be presented to the commanding officers for their approval and indorsement. The object of this committee will be to promote the welfare of the nurses within the center, and to maintain a high standard of service and conduct within the Army Nurse Corps.⁴

6. To act as hostess of the center. In that capacity she will meet each new chief nurse arriving at the center and see that the latter has all information that will assist her in the performance of her duties. She will also, in cooperation with the commanding officers and chief nurses of the center, endeavor to promote a wholesome social life among the nurses.

This plan was based on the British system, which had proved satisfactory.³ Although, as stated above, it was not put into operation in the American Expeditionary Forces until shortly after the armistice was signed, it proved to be a decided success.³

CAMP HOSPITALS

Army nurses were assigned to camp hospitals,³ which in most instances were in isolated areas but which functioned much in the same fashion as base hospitals, only on a smaller scale.

EVACUATION HOSPITALS

The evacuation hospitals of the American Expeditionary Forces had from 1,000 to 1,500 beds. Under ideal conditions they were located at a rail head, within from 8 to 10 miles of the front lines, so that the wounded could be brought to them in a short time by ambulance and either be operated on at once or sent by train to hospitals to the rear.¹⁰ In actual functioning, from the nursing point of view, there was little difference between them and the base hospitals, except that, generally speaking, the turnover of their patients was more rapid.

MOBILE HOSPITALS

Mobile surgical hospitals were institutions which were destined for activity near the front lines. They were usually established in tents;¹¹ so their personnel had to be skilled in the rapid setting up and taking down of tents, as these hospitals were forced to be able to move on very short notice. They had complete equipment for operations, their own laundries, sterilizing trucks, and electric-lighting plants. Many of them had portable equipment on trucks which could be incorporated into a tent system in such a way as to function as a room. For instance, X-ray and sterilizing trucks could be attached to

the operating-room tents. The whole equipment could be taken down, packed onto trucks, transported a considerable distance, and set up again on the same day.¹¹

The staff usually included 20 nurses, or 19 nurses and the chief nurse.¹¹ Necessarily, conditions in so far as the nurses in these organizations were concerned, were of the most primitive. A special tent was used for the nurses' quarters, and it usually contained very little more than beds and the nurses' locker trunks in which they kept all their necessities and on which they placed their wash basins and pitchers.¹¹

Mobile surgical hospitals could make few provisions for comfort or convenience. The mess tent usually contained, for dining-room equipment, trestles with boards over them for tables, and benches for chairs. If oilcloth was available, that was used for table covering, and the easily transportable enamel plates and bowls were the table furnishings.¹¹

Screens and mosquito netting could not be installed in these rapidly moving units, and as they frequently had to be set up in areas which had been fought over there was often much annoyance to be endured from flies.¹¹ In some mobile hospitals recreation tents for the nurses' use were provided by the American Red Cross.¹¹

FIELD HOSPITALS

Nurses were not intended for assignment to field hospitals, but there were occasions in which nurses found themselves on duty with such hospitals after having been assigned to duty on special surgical teams which were moved about as the need arose. Under such conditions formal reports of this service were never submitted, as there were no chief nurses on duty with these teams, but the nurses' individual records indicate that a number of nurses had varying lengths of service in connection with field hospitals.³

HOSPITAL TRAINS

Hospital trains formed the connecting link between the front-line and the base hospitals. Each train unit was complete, frequently organized as such in the United States; however, nurses were not attached to the hospital trains until several months after the hospital-train service had been functioning. The duties of the three nurses assigned to each of the trains were outlined in general instructions which were issued to the officers in charge of the trains:³

The senior of the three nurses assigned to the train will act as matron. Nurses will carry out the orders of the medical officers, and are to be obeyed next after them.

The nurses were assigned quarters within the staff coach, and one of them was obliged always to be on duty. When it was possible for a nurse to leave, she could be gone no longer than two hours.³

The duties of the nurses on hospital trains were performed under difficulties. It was necessary for them to accustom themselves to the restricted quarters, the constant motion, and the uncertainty and irregularity of the hours of duty. The character of the duty on the hospital trains made it imperative that extreme care be exercised in the selection of nurses for such details. The limited space, the necessity for close association of officers and nurses, and the isolation from other groups of workers made hospital train duty a severe test of the persons

assigned to it. Professional skill, great physical endurance, adaptability to unusual living and working conditions, ability to meet emergencies, and the possession of steadfast high principles were some of the qualifications found to be most desirable in a nurse on duty with a hospital train.³

Experience proved that certain improvements could be applied to the nursing branch of this service, such as frequent inspections by a representative of the nursing service, means of recreation, limitation of period of duty on a train, and a system whereby nurses' clothing could be replenished at definite points on the route, and thus do away with the necessity of the nurses washing their own clothing.³

NURSES' LIVING CONDITIONS

QUARTERS

The degree of relative comfort which could be attained by the American nurses living and serving in war-ridden France was surprising. Frequently it



Fig. 6.—Nurses' quarters of the semipermanent barracks type

was necessary to use unequipped and poorly arranged rented buildings, because of the inadequacy of new construction. Such buildings included factories, schools, barracks, and hotels.³ Very few of these buildings contained running water, toilet facilities, or sewer connections, and the heating systems were almost uniformly poor. With characteristic American spirit, the nurses adapted themselves to most uncomfortable conditions, even at severe risks to their health. Wet cement floors which caused mildew to any articles left thereon; leaky roofs, which admitted wind and rain; impossible toilet and washing facilities; and the necessity in many cases for nurses to do their own laundry were a few of the discomforts attendant upon living in the unsuitable quarters.³ Gradually, as soon as it became possible, regulation brick or wooden barracks were constructed which provided, among other improvements, heat in the hallways and indoor toilets and washrooms. Such barracks usually allowed one room for each two nurses, and the contrast of such quarters to those provided in most of the rented buildings was marked.⁹

FOOD

Since nurses on duty in hospital were rationed, at times it was inevitable that the ration be limited in variety, quantity, quality, and attractiveness, and at such times only keen appetites sharpened by hard work made it possible to eat the meals. It was demonstrated that the mess was generally more successful when the officer in charge was assisted in its planning by a nurse detailed to that duty.³ Cooks and waitresses were drawn from the enlisted ranks and from the French towns. The comfort in many of the nurses' messes depended upon the ideas of the chief nurse and the cooperation of the commanding officer in securing

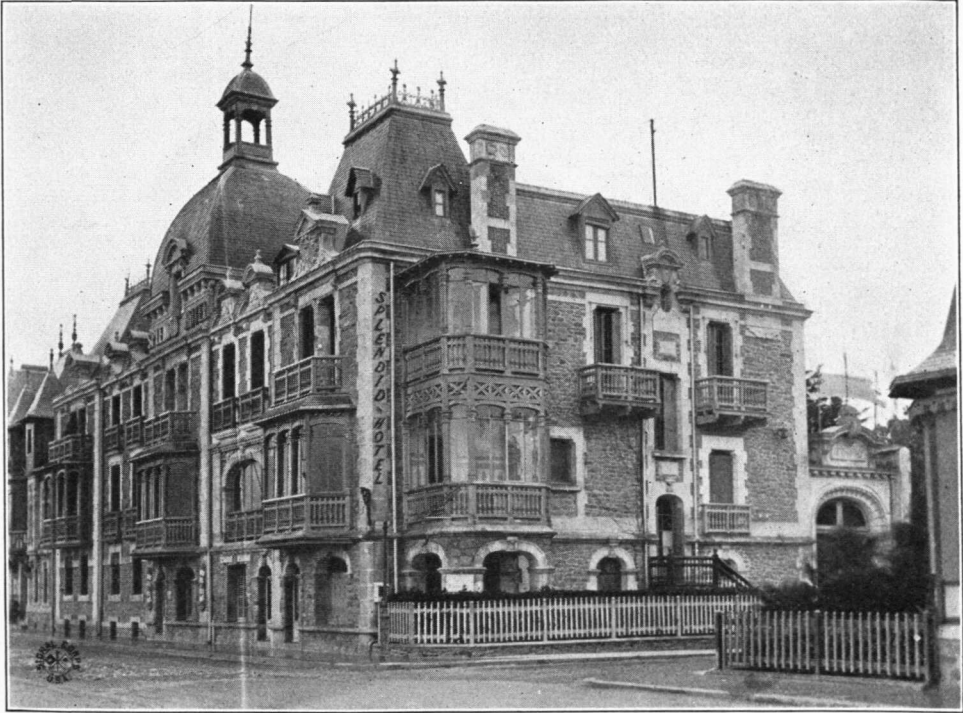


FIG. 7.—Nurses' quarters, Camp Hospital No. 91, La Baule, France

supplies. In many cases nurses ate off bare boards with the crudest of enamel dishes; in others, they were supplied with attractive china, tablecloths, and all the proper dining-room equipment.³ Through the efforts of the nurses themselves, curtains, lamp shades, and growing plants were secured, which added greatly to the attractiveness of the dining rooms. In the same way, the question of service was entirely a matter of locality and cooperation.³ The employment of women to serve as maids and cooks for the nurses' mess was the most satisfactory arrangement.³

Occasionally it was necessary for the nurses to stand in line and to be served their meals in their mess kits as were the soldiers.⁵ Fortunately this did not happen very often as it was most unsatisfactory.⁵

LAUNDRY

For the nurses the question of laundry led to much discomfort. Some of the hospitals were able to provide their own laundries, some secured French women to do the work, and sometimes the work was done in French laundries in neighboring towns.³ In many cases, however, the nurses themselves had to launder their own clothing, including their uniforms.³ This was a hardship, particularly during the times when their physical strength was taxed to the utmost in caring for their patients. The director of nursing service on her inspections of nurses' quarters noted but few rooms in which during the winter months, flannels were not hanging to dry. The lack of proper facilities for laundry work and the dampness of the winter months made it necessary for



FIG. 8.—Nurses' quarters, Base Hospital No. 29, Tottenham, England

many of the nurses' rooms to be "festooned" with wet flannels from one week end to another.³

Mobile hospitals which were equipped with portable laundries seemed to solve the problem in the best way.³

RECREATION

Opportunities for recreation for nurses were often very limited.³ Muddy roads frequently eliminated walking in places where that was the only chance for diversion. Dim lights prevented reading, writing, or sewing in the nurses' rooms, and even when general living rooms were provided they frequently were too cold and too poorly lighted to permit of any enjoyment from playing cards or other indoor games. In the hospital centers the American Red Cross grad-

ually provided recreation huts equipped with libraries, moving-picture apparatus, and musical instruments; in some places they even built special huts for the nurses' recreation houses.³ These recreation houses were like private club-houses and were fitted with assembly rooms, libraries, kitchens, sewing rooms, and laundries. Here the nurses could entertain with simple meals, teas, dances, and other social activities. The next step in the direction of improvement was

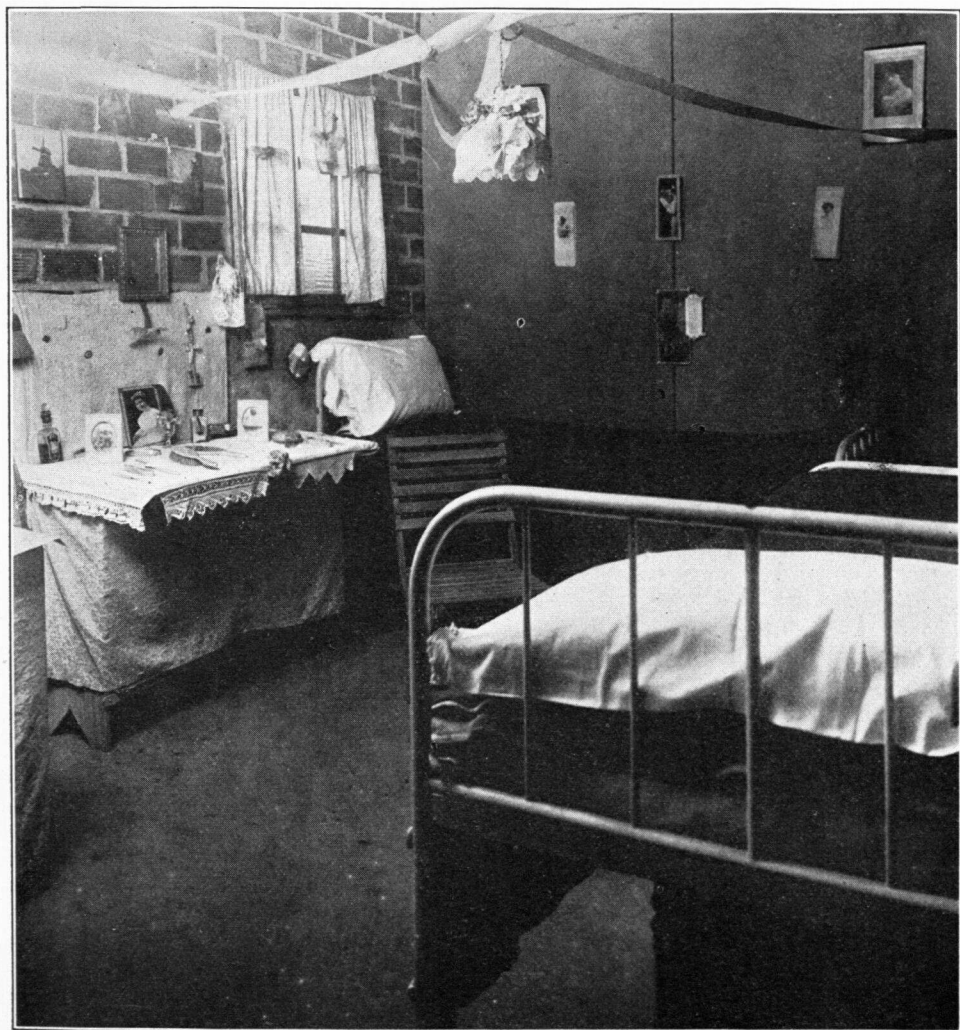


FIG. 9.—Interior of nurses' quarters, semipermanent barracks type

when Young Women's Christian Association secretaries were assigned to duty as hostesses of the recreation huts. About 30 were detailed to such duty, and they proceeded to organize classes and courses, and to provide entertainments.³ This proved a great help at a time when some form of diversion was imperative to uphold the morale and to stimulate the spirits. The presence of these women was of the greatest assistance to chief nurses whose energies could be devoted to purely professional work.³

Cessation of hostilities led the way to further relaxation, and likewise afforded more time for recreation. The sense of relief which pervaded the minds of all found expression at times in ways which required a controlling rein, but never did outside amusements cause the nurses to lose their enthusiasm or interest in the welfare of their patients.³

CARE OF SICK NURSES

The methods of caring for sick nurses varied according to the hospital concerned, and usually to the number of nurses who needed hospital treatment.³ In some instances nurses were cared for in their quarters; in others, a special part of the nurses' quarters was set aside as an infirmary, attendant nurses



FIG. 10.—Nurses' mess hall, Base Hospital No. 17, Dijon, France

being assigned to duty there. Still other hospitals assigned a ward or a portion of a ward exclusively for the care of sick nurses. When base hospitals were grouped in centers, the general practice was to establish a center infirmary to which all the sick nurses of all hospitals of the center were sent for treatment.³

Disabled nurses were classified by medical boards and evacuated as were officers and men.³ Sick nurses who had to be returned to the United States were sent to port hospitals at Savenay, Bordeaux, or Brest, and their conditions passed upon there. If it was decided that they should be returned to the United States, and transport accommodations were available, they were returned without delay.¹² In cases where nurses were sent back to the United States in this manner, statements were sent to the Surgeon General's Office, at Washington, D. C., to the surgeon, port of embarkation, and to the chief surgeon, A. E. F., setting forth the facts as to the reasons for return.¹³

LEAVES OF ABSENCE

Members of the Army Nurse Corps in the American Expeditionary Forces were granted leaves of absence under the same conditions as were officers and men. These provisions made allowance for seven days of leave every four months, not inclusive of travel time;¹⁴ however, during the active months of the war it was not possible for nurses to be given their leave allowances regularly. Nurses who did obtain leave usually went to Paris, though some went to the Riviera.³ After the armistice began, however, leave areas were unrestricted, and thus, unlike the nurses who served with the British Expeditionary Force in France, who were allowed to go to England and only to certain portions of France while on leave, the nurses on duty with the American Expeditionary Forces had almost unlimited opportunity for traveling and sightseeing.³ Chief nurses were



FIG. 11.—Nurses laundering their wearing apparel

instructed by the chief surgeon's office, A. E. F., to urge as many members of their staffs as could be spared without detriment to the service to avail themselves of leave.³ This was especially important for the morale of the nurses, because of the inevitable reaction after so many months of strain incident to war duties.³

DIFFICULTIES EXPERIENCED INCIDENT TO TRAVEL

Travel in France under the most favorable of circumstances was filled with difficulties. Trains were almost invariably overcrowded; there were no porters; cabs were very scarce; frequently no hotel accommodations were available at a particular place, and the necessity of sleeping in railway stations or in ambulances or in other uncomfortable situations and of getting food wherever it was possible to snatch it was common to officers, nurses, welfare workers, and soldiers; in fact, to anyone who endeavored or was required to travel.

Long waits in cold, damp stations often were followed by protracted trips in slow French trains, too often in second and third class coaches.⁹ Second and third class coaches frequently were delivered, despite the fact that, in accordance with instructions, first-class coaches had been ordered from the French for the transportation of nurses.³ The officers who received this unsuitable kind of transportation for nurses were often in a quandary as to whether to accept it or to refuse it. Although inadequate, if it were refused, it might cause unwarrantable delays in transferring nursing personnel.

There are letters of record from nurses giving accounts of their travels in France during the early part of the war, when conditions were very poor.³ Some of these stories tell of train trips of unknown lengths undertaken by



FIG. 12.—Interior of nurses' recreation hut, Base Hospital No. 27, Angers, France

nurses on their way to other stations in which rations were issued to them consisting largely of tinned food. Candles were also issued, as the trains had no lighting arrangements. Most of the nurses considered these trips in the nature of a lark, but were glad that it was not necessary to continue them for extended periods. Little harm was done by trips of this sort, but certain risks were taken, particularly in connection with the lack of facilities for the care of sudden acute illnesses among the nurses.³

One of the greatest causes for discomfort of nurses during traveling was the frequent lack of any toilet facilities whatsoever.³ Only where exceptional thoughtfulness was displayed by the officers in charge of transportation was this distressing state of affairs rectified. Instances are on record where one or two nurses traveling at the front on surgical teams were the only women on a

train filled with officers and troops. They were required to travel in compartments with the officers, and no privacy was afforded them at any time during the journey, whether it was for the period of 1 hour or 24.³ It took moral courage and sensible frankness to meet this problem and to deal with it effectively.

Instances are known of the great resourcefulness shown by various chief nurses in the conduct of their nursing staffs from one place in Europe to another. During the early part of the war it was not unusual for the entire personnel of base hospitals to be landed at Liverpool and there for the nursing staff to be separated from the officers and men.³ Under conditions such as these it became the responsibility of the chief nurse to conduct groups varying in size from 65 to 100 women with all their baggage from that place in the north of England to somewhere in France.³ One chief nurse who had never before been in Europe and who had no knowledge of the French language, and for whose group no previous provision had been made, made all of the arrangements for getting 100 nurses onto a train in Liverpool which took them to London. In London she conducted them from one railroad station to another in the underground tube, and by vigorous methods succeeded in persuading the station master to add other coaches to a train about to leave for Southampton in order that her group might not be obliged to remain in London for the night. At Southampton she secured accommodations for them and on the next day arranged for their transportation to Havre. Here, for the first time, she secured the assistance of American officers, through whose help she placed her group on a French train with sufficient food to last them for a trip of nearly 30 hours. Such an instance as this was not very remarkable during the early months of the war.³

Early in January, 1919, the director of nursing service, A. E. F., wrote the following letter to the chief surgeon, A. E. F., regarding assistance to nurses who were traveling:³

Incidents are constantly occurring when nurses traveling on orders to base ports for embarkation, frequently for reasons of physical disability, are encountering great difficulties and discomforts. These difficulties are due to the crowded conditions of the trains, the nurses' unaccustomedness to traveling alone in a foreign country, and, more important yet, their physical disability. Such disability is usually not of such a nature that the nurses should be sent as patients. Nurses are obliged to carry their own heavy bags and to scramble for seats when they are not fit to do so, especially when changing trains. Many nurses change trains at Tours on their way to ports of embarkation. Can arrangements be made to assist such nurses at Tours? Can arrangements also be made to assist such nurses at all times of the arrival of trains at Bordeaux, Brest, and Nantes (for Savenay)? Incidents have also occurred where nurses traveling on orders from one station to another have been obliged to spend the night in railway stations. A few days before December 23 a group traveling from Rouen to Chatillon-sur-Seine (Camp Hospitals 38 and 64) spent the night in the station at Troyes, as it was impossible to obtain accommodations in hotels. Can any instructions be given or any foresight taken that will prevent such occurrences?

To obviate some of these difficulties for the nurses, commanding officers of hospitals which nurses were leaving were instructed to see that the commanding officer of a hospital situated in the town near the next station at which nurses might be required to change cars or to leave the train should be notified in order that he might send a detail to look after nurses' baggage and to make any further

necessary arrangements for them.¹⁵ Hundreds of nurses were benefited by this order and were met by ambulances to take them to hospitals overnight, and were sent on their way the next day in comfort.³

PROBLEMS OF CHIEF NURSES

Chief nurses had a greater variety of problems to deal with in France than most of them had ever before encountered. Not only did they have the routine administrative activities to deal with, such as the distribution of nurses and the supervision of their duties, but they frequently had very serious practical problems to solve.³ As stated above, housing conditions were frequently anything but comfortable. Often it was necessary for the chief nurse herself to make purchases for the nurses' mess, when some one else could not be delegated to attend to this duty regularly; also to hire, train, and supervise employees, most of whom could not speak English, for not only were French women and girls employed as cleaners, maids, cooks, etc., but numbers of Belgian refugees were used in the same way.³ These problems, however, were of relatively minor significance as compared with those which arose in connection with oversight of the general conduct of the nurses.

The maintenance of morale among our nurses and the observance of the customary social amenities of life were matters which presented many difficult phases. It should be realized that in France in almost every station where nurses were on duty there were none of the usual social inhibitions or traditions or things that "weren't done." In the United States the customs or institutions of a locality or a community presented many brakes to impulses and desires, but in France for our nurses none of these things obtained, and the only influences that could be brought to bear upon situations were those which were in each nurse's individual background or in the careful supervision and regulation by the chief nurse. In civil hospitals at home chief nurses had training-school committees in many instances or boards of lady managers to whom they could turn for advice, and superintendents of nurses who were confronted by big problems could bring them up for discussion at conferences of nurses holding similar positions, but in France, particularly in isolated localities, the chief nurse was in a most difficult and lonely position because of the lack of such counselors and guides. Though, generally speaking, a great amount of support and assistance was given to the chief nurses by many of the commanding officers with whom they were associated, and also by many members of the medical staffs, where such cooperation or interest on the part of the masculine administrative group was lacking, the position of the chief nurse was probably one of the hardest in which a professional woman was ever placed. It must be remembered, too, that there were many different ideas regarding conduct and social regulation. The British had their customs and traditions in these matters; the French had theirs; and the Americans who, even in small groups, came from very different parts of the country, had theirs. Even in the same hospital center ideas of conduct and local restrictions for the behavior of the nurses of the separate units varied markedly. In this connection the value of center chief nurses was notable, for they, in conference with the individual chief nurses of the units in the center, could formulate suggestions in these

matters which would be uniform for all the units in a center. As center chief nurses were gradually appointed such suggestions as these were carried out with marked success.³

There were few units which did not lose one or more nurses by death, and even those that did not went through the agonizing experience of serious illness among the nursing staff. When it is recalled that most of the nursing groups were units that came from some parent organization in the United States, and contained women who had been friends for years, and that in many instances the parents of members of the staffs had personally confided the welfare of their daughters to the chief nurse, the anxiety and the responsibility of chief nurses can perhaps be partly imagined.³

In the case of death among the nurses, upon the chief nurse fell the duty of writing to the parents and describing the details as best she might, of readjusting the duties among already overworked women, of assisting at funeral ceremonies, of keeping up morale, and also of arranging for the nursing of other sick members. It takes but little imagination to picture the frame of mind of a chief nurse who had gone through this process twelve times in one month, as once happened during the period of the influenza epidemic. The cumulative effect of so many funerals would have had serious consequences under normal conditions, and 3,000 miles from home, in a foreign land without the usual means of diversion, it took strong character to withstand the pressure.³

BASE SECTION NO. 3, ENGLAND

In June, 1918, an Army chief nurse and an assistant were assigned to duty in the office of the chief surgeon of Base Section No. 3, England. These two executives relieved two nurses who had been on duty in that office since the February preceding. Their duties consisted of the general supervision of all the nursing personnel of United States Army hospitals in Great Britain.³

Ten hospitals with American Army nurses functioned in this section, and three of these were American Red Cross military hospitals. During the influenza epidemic of October, 1918, 300 nurses who were en route to France were attached temporarily to the hospitals in this section where they were most vitally needed. This did not entirely relieve the pressure, so 100 members of the British voluntary aid detachment were procured through the British War Office and were distributed among the hospitals.³

Though authority was contained in the Army appropriation bill of July, 1918, to appoint one director and two assistant directors of nursing service in England, since there were comparatively so few nurses in Base Section No. 3 it was not necessary to utilize this allowance.³

During the war period 24 American-trained nurses, the majority of whom were British subjects, were transferred from the American Red Cross nursing service to the Army Nurse Corps while they were on duty in Base Section No. 3.³

The chief nurses of this section, in addition to the usual problems incident to service in a foreign country, had also the difficulty of being much isolated and of having very little opportunity to confer with other nurse officials regarding matters of administration and discipline.³

IN THE ARMY OF OCCUPATION

On December 2, 1918, a part of the personnel of Evacuation Hospital No. 3, including 25 members of the Army Nurse Corps, proceeded by ambulance to Trier, Germany, for duty with the American Army of Occupation. This detachment took over a German hospital, the German nursing staff remaining on duty for about a week thereafter. Soon after several other evacuation hospitals were established in Germany. These organizations were really advanced base hospitals and did the work of such.¹⁶

Each hospital in the Third Army had as a rule the proportion of 1 nurse to every 10 patients, and the maximum number of nurses on duty in the Army of Occupation at one time was approximately 700.¹⁶ Some months after their arrival, it was decided upon the recommendation of the director of nursing service, A. E. F., to assign to the office of the surgeon of the Third Army a chief nurse whose duties were outlined as follows: To be responsible for incoming nurses reporting to the surgeon's office for assignment; to handle all papers relating strictly to the Nurse Corps; to submit recommendations to the personnel officer regarding assignments and transfers of nurses; to keep the surgeon of the Third Army fully informed regarding all matters concerning the nurses; to systematize and standardize the rules, regulations, and social policies governing nurses in the army area; to keep in touch with the director of nursing service, A. E. F., regarding her policies; by frequent visits, to keep informed of the conditions in the hospitals of the army area, as they affected the nurses, such as quarters, mess, recreation, care of sick nurses, etc.

The problems which arose in connection with the nursing staff in the Army of Occupation had a distinctly individual character, due to the nature of the work, which was not heavy, and to the circumstances of life in an occupied area. There were no precedents for conditions of this sort, and as had happened elsewhere in the American Expeditionary Forces, they had to be worked out one by one as they arose, rather than in accordance with any policies that previously had been formulated. Opportunities for sightseeing trips or for participating in social occasions of all kinds were not unique in the nursing service but were apparently the order of the day in all branches of the Army. From the time of the advent of the first nurses into Germany endless invitations poured in from every near-by section to social functions of all sorts. Celebrations and festivities of every nature were organized, and there seemed to be no reason why nurses should not go from one part of the occupied area to another. This practice, however, produced complications with regard to temporary living conditions, and it was necessary in consequence to curtail the practice so far as nurses were concerned. At a conference of commanding officers of the hospitals of the Third Army it was decided that nurses should attend no social affairs excepting those in their own hospitals. Each hospital usually had one or two dances to which the nurses were privileged to invite anyone they chose.¹⁶

It was necessary because of the natural resentful attitude of some of the populace to require nurses never to be on the streets after 7 in the evening unless in groups of two or more, accompanied by proper escorts. They might be out after 9 o'clock only with written permission from their chief nurse, approved by the commanding officer.⁶

Great insistence had to be placed on the wearing of the Army Nurse Corps uniform at all times as a matter of protection and identification.⁶

Nurses were instructed not to enter cafés and not to dine in officers' quarters or messes. They were not allowed to dine in hotels which were operated by Germans and which used German food supplies, but there was no objection to their dining in hotels which were under American control. Social relations with the enlisted men were not permitted, and nurses were forbidden to ride in Government motor vehicles, except when they were on duty.⁶

DISPOSITION OF NURSES AFTER THE ARMISTICE BEGAN

After the armistice began the immediate effect of a decline in enthusiasm and morale was widely felt among the nursing staffs, as well as among officers and men. This was evidenced by the large numbers of requests for transportation to the United States which were received at the office of the chief surgeon, A. E. F.¹⁷ The urgent need for nurses, however, did not decrease until several weeks after the armistice began, but plans were formulated rapidly by which entire groups of nurses could be returned to the United States. At this time increased activities of the American Red Cross among returning refugees, prisoners, rapidly developing institutions for children's work, and tuberculosis patients, with Red Cross commissions in the Balkan States and the Near East, gave opportunities for those nurses who wished to remain longer in Europe to be relieved from active duty with the Army Nurse Corps and to be taken over for service directly under Red Cross commissions. The close cooperation between the office of the Red Cross nursing service at Paris and that of the nursing service of the Army made it possible for this transfer of status to be made with the least possible loss of time and without confusion.¹⁷

CONCENTRATION AND EMBARKATION CAMP

To facilitate the return of nurses to the United States, beginning in January, 1919, Camp Hospital No. 91, at La Baule, functioned as a centralization point for the Army Nurse Corps under orders to return to the United States.¹⁸ This location was chosen because La Baule is a seaside resort not far from the Savenay Hospital center and the port of St. Nazaire, and but a short distance by train from Brest. The nurses who were sent to La Baule to prepare for return to the United States were housed in four large hotels, built of brick or stone, of excellent construction, but without arrangements for central heating. They were, on the whole, very comfortable except in the cold, damp, and rainy season of January, February, and March.¹⁸

The average length of stay for the units at La Baule was from 10 to 15 days, as it required much time to complete the records and make arrangements for the journey to the United States.¹⁸ Frequently the four hotels were taxed by the many units reporting there simultaneously. During the first month that nurses were sent there for concentration the following organizations had arrived to await evacuation:¹⁸

	Nurses		Nurses
Mobile Hospital No. 39.....	19	Base Hospital No. 24.....	28
Base Hospital No. 2.....	111	Base Hospital No. 15.....	66
Base Hospital No. 66.....	10	Base Hospital No. 42.....	29
Base Hospital No. 18.....	47	Base Hospital No. 41.....	81

Entertainment was provided by the American Red Cross and also by the administrative staff of the hospital in the form of bus rides to St. Nazaire, auto trips, dances twice a week, and moving-picture shows.¹⁸

When the time came for the units to be transferred to Brest, each group was placed under the supervision of an officer. As many of the base-hospital units had been broken up, and as a chief nurse frequently would arrive at the center with a small group, it was decided to send groups of 50 nurses home and, if a chief nurse was available, to put her in charge of a group.¹⁸ If no chief nurse was available, a nurse was assigned as acting chief nurse and given charge of a group.¹⁸ Although many nurses were sent from La Baule to St. Nazaire and Bordeaux for embarkation, the majority went through Brest.¹⁸

Another important concentration camp for nurses was at the Vannes Hospital center. This center included not only Vannes, but also Auray, Plouharnel, Carnac, and Quiberon.¹⁹ At Vannes the one hospital, Base Hospital No. 136, was in old French buildings which formed three sides of a quadrangle and which previously had been French barracks. The buildings were very dirty and required an unusual amount of work to convert them into a decently livable place. There were no proper toilet arrangements, no electricity, and gas in but a few of the buildings. The only advantages of the place were an abundance of room, plenty of potable water, and freedom from mud. This hospital was the nucleus of the center.¹⁹

On May 30, 1919, there were 1,157 nurses at Vannes awaiting orders to return to the United States.²⁰

The Kerhoun Hospital center had a capacity for 4,000 évacuées. Ninety per cent of its activity was devoted to receiving, preparing, and evacuating patients to the United States. In February, 1919, it was decided to set aside here a block of 13 wards, with a capacity for 500 nurses, to care for nurses properly who were being returned to the United States.²¹ In addition to providing quarters and food, it was found necessary to pay, clothe, and provide laundry facilities for these transient nurses. A large stock of nurses' clothing was obtained, and frequently as many as 500 nurses were outfitted in one afternoon. From February 1 to April 30, 1919, 3,960 nurses were accommodated here, awaiting transportation to the United States.²¹

The quarters for the casual nurses were in barracks, some of which were located at a distance from the latrines and showers. The showers were installed in a barrack-type bathhouse, where the nurses could also use laundry facilities. A French woman attended to the fires and to cleaning the bathhouse.⁶

The casual nurses were assigned to a separate mess hall which had a capacity of 370. At one time cafeteria service was used, but later it seemed practicable to have the food served the nurses at the table. On account of laundry conditions no tablecloths were used.⁶

The question of the entertainment of the transient nurses at Kerhuon was an important one. Naturally they were eager to return home and chafed at the

delay incident to the departure of the vessels on which they received transportation. They were allowed to go to Brest at any time when there was possibility of their unit receiving orders, and special ambulances conveyed them to town twice every day. The American Red Cross hut was increased to twice its size and provided one of the best dance halls in the vicinity. Tea was served there every afternoon, and when there were more than 100 casual nurses present tea was served in the individual barracks. The orchestra played every afternoon at the teas and also during dances in the evenings.²¹

Special barracks were set aside for the accommodation of sick casual nurses, and a nurse was placed in charge of each of these barracks.²¹ Improvements were gradually applied to the system of caring for sick nurses.⁶

In the Kerhuon Hospital center there were constantly from 400 to 500 transient nurses, and from 2,000 to 3,000 ambulatory patients.²¹ The problem

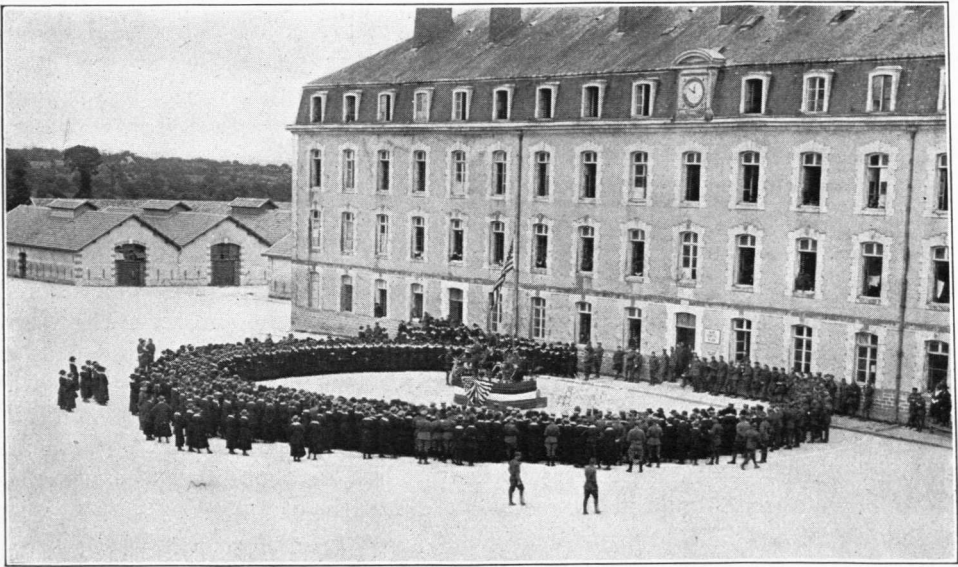


FIG. 13.—Embarkation center for nurses, Vannes, France

of the relationship of nurses and enlisted men in a place of this sort where so many were congregated without adequate occupation or amusement was an especially difficult one. Prior to April 1, 1919, association between nurses and enlisted men was confined by orders strictly to official business.²¹ When the order prohibiting restriction of association was received, all restrictions were removed, and the result was well-nigh disastrous. Transient nurses and patients were to be found everywhere about the walks and grounds. Within 48 hours the sections of the center used by permanent and transient nurses as quarters had to be placed out of bounds to enlisted men on the urgent request of the nurses themselves.²¹ The indiscriminate association of nurses and patients, morning, afternoon, and evening, resulted in a distinct lowering of discipline, not only to the patients, but also to the enlisted personnel. Prohibition of association between nurses and enlisted men was reestablished only when it became manifest that it was absolutely essential to do so. It became a question of

reestablishing the prohibition or discontinuing having transient nurses here; the former action was taken in the middle of May, 1919, after which time no further trouble was experienced.²¹

The overcrowding of nurses in uncomfortable quarters, the long delay, and the lack of occupation caused great unrest and dissatisfaction among them. Although every effort had been made at the chief surgeon's office, A. E. F., to expedite the departure of portions of this large group of nurses to the United States, the relief of the situation was hardly perceptible. At about this time the officer in charge of transportation, chief surgeon's office, A. E. F., requested the director of nursing service to go to Brest in order that she might ascertain for herself the exact situation with regard to available facilities for the return of nurses to the United States.³ The director had a conference with the transportation officers at Brest, and when they showed her lists of sailings for the following few weeks of vessels with 20,000 berths and at the same time showed lists of Americans, including troops, members of the Army Nurse Corps, and various welfare workers, and the question was asked just what could be suggested, there was, of course, no answer forthcoming, except to urge that nurses be sent back as soon as possible. Since only a certain portion of women could be accommodated on each transport, naturally the officers in charge of transportation were greatly put to it to choose between the types of women workers who should be given preference.³

HEALTH OF NURSES—CASUALTIES

On the whole the health of nurses in the American Expeditionary Forces was very good. The influenza epidemic of 1918 affected members of the Nurse Corps as it did the men of the Army. Only two nurses were wounded at all seriously, and none were killed by the enemy. By the time the first nurses in France had been there a year only six deaths had occurred among them, and at this time there were 2,500 nurses in the American Expeditionary Forces. Up through August, 1918, there were 15 deaths; but in September there were 8 more, in October, 41, and in November, 12. Deaths of nurses by months were as follows:²²

Month	Number	Month	Number	Month	Number
1917		1918		1919	
May.....	2	May.....	1	January.....	5
November.....	1	June.....	3	February.....	8
December.....	1	July.....	2	March.....	2
Total.....	4	August.....	1	April.....	2
1918		September.....	8	May.....	4
January.....	3	October.....	41	June.....	1
February.....	1	November.....	12	Total.....	22
March.....	0	December.....	4		
April.....	0	Total.....	76		

As was to be expected, although it is probable that such things were not in most people's calculations in connection with the war, a normal amount of accidents occurred among the nurses. One was killed in an airplane accident, another was run over by a train, another was thrown from a horse, and a number were killed in automobile accidents.²² Exercise of all sorts and diversions of

every description were necessary, and death under such circumstances was in line of duty. It should be noted that the proportion of suicides among the nurses was abnormally low. Of the 10,066 nurses in the American Expeditionary Forces but one of them committed suicide.²²

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- (11) Histories of mobile hospitals. On file, Historical Division, S. G. O.
- (12) Letter from Bessie S. Bell to Dora E. Thompson, May 18, 1918. On file, Army Nurse Corps Section, Personnel Division, S. G. O.
- (13) Letter from chief surgeon, A. E. F., to commanding officer, Base Hospital No. 8, A. E. F., May 3, 1918. Subject: Nurses Returning to United States. On file, Army Nurse Corps Section, Personnel Division, S. G. O.
- (14) General Orders No. 6, A. E. F., January 8, 1918.
- (15) Circular No. 65, Chief Surgeon's Office, A. E. F., January 15, 1919.
- (16) Report on the hospitalization for the Army of Occupation in Germany, undated, by Maj. H. C. Maddux, M. C., United States Army. On file, Historical Division, S. G. O.
- (17) History of American Red Cross Nursing Bureau. On file, Army Nurse Corps Section, Personnel Division, S. G. O.
- (18) History of Camp Hospital No. 91. On file, Historical Division, S. G. O.
- (19) History of Vannes Hospital Center. On file, Historical Division, S. G. O.
- (20) Account of services in Army Nurse Corps overseas, by Mrs. L. L. Vandervort, former chief nurse, Army Nurse Corps. On file, Army Nurse Corps Section, Personnel Division, S. G. O.
- (21) History of Kerhuon Hospital Center. On file, Historical Division, S. G. O.
- (22) Based on sick and wounded reports made to the Surgeon General.

APPENDIX

APPENDIX

UNIT COURSES OF STUDY¹

Rehabilitation monograph. Joint Series No. 4.

Unit Course—English I—Instructor's Manual

ENGLISH FOR NON-ENGLISH-SPEAKING MEN ILLITERATE IN THEIR NATIVE LANGUAGES

January, 1919—Trial edition

A. QUALIFICATIONS OF STUDENTS

This course is intended for those men of foreign birth who can not read or write in their native languages. Such men are strictly illiterate. Generally they speak some English very badly and understand simple direct conversation fairly well.

Their most urgent need is training in learning how to write their names and the facts of personal identification, and in learning how to recognize the English alphabet and the fundamental phonetic sounds as expressed in elementary reading.

B. AIM OF COURSE FOR STUDENTS

This unit course provides such training in elementary writing and reading as will raise the student from the state of strict illiteracy to the grade of elementary literacy. The work is necessarily intensive in its nature and the material has been selected to meet the special needs of this problem.

C. APPROXIMATE TIME

This unit course is divided into 12 assignments. The average student will complete the work of one assignment in approximately 75 minutes. This period may be divided thus:

	Minutes
Writing.....	20
Phonics.....	20
Dictation.....	20
Reading.....	15
	<hr/> 75

In many cases this time allotment will prove too short. Care must be exercised by the instructor in extending this time for any lesson. The average illiterate can not concentrate on instruction, study, and recitation for a longer period. He should be encouraged, however, to do considerable practice work on his writing during his free time in the ward. The instructor may readily provide him with some simple elementary copying assignment to be done "out-of-class" each day.

The total number of hours will average 15 for this unit course.

D. EQUIPMENT

(a) *Paper*.—Ruled paper for all work in this course.

(b) *Pencils and pens*.—Soft pencils should be used until the student has mastered the alphabet. Stub pens should then be provided.

(c) *Textbooks*.—No textbook is used during the work of the first nine assignments. Lessons 10, 11, and 12 require the use of Field and Coveney's "English for New Americans," Silver, Burdett Co., New York (\$0.70), or O'Brien's "English for Foreigners" (Book I), Houghton Mifflin Co., New York.

¹ In the series of the unit courses of study reproduced herein, Unit Course No. 1, 2, and 3 have been omitted by reason of the fact that they are not didactic in character, but are generally informative as to what the Government intended to do in the way of rehabilitating the disabled soldiers. Practically all of the original illustrations have been reproduced. Also Unit Courses Nos. 66 and 67 have been omitted. Unit Course No. 66 deals with the bibliography of books for instructors and students; No. 67 concerns bookkeeping—partnership business for professional accountants.—*Ed.*

(d) *Reading cards.*—The reading lesson in assignments 1 to 9 must be printed on the board by the instructor in large letters. Sight cards must also be used. The instructor must determine how these cards are to be available for use. They can be stenciled, printed, or prepared with brush and ink. A rubber stamp printing outfit will be very handy. This can be secured from any kindergarten school supply house. A good outfit will cost \$5.

(NOTE.—Size of card, 6 by 15 inches. Size of letter, $\frac{1}{2}$ inch. One sentence on a card.)

The contents of the reading lesson which must be printed for each assignment is as follows:

Assignment 1

We are in a hospital.
We come to school every day.
We are learning English.
----- is our teacher.

Assignment 2

I am a soldier in the United States Army.
I am a patient in this hospital.
I am in ward -----

Assignment 3

I want to be a citizen of the United States.
I must learn to read English.
I learn to write English in this school.

Assignment 4

I am a soldier and a patient in this hospital.
We learn to read and write English in this school

Assignment 5

Every good citizen should learn to read and write English.

Assignment 6

The United States, France, England, and Italy are allies in this war.

Assignment 7

This is -----, 19 (date).
This is ----- (day).
Yesterday was ----- (day).
To-morrow will be ----- (day).

Assignment 8

We are patients in General Hospital -----
Our address here is, "General Hospital -----"

Assignment 9

General Pershing is the commander of the American troops in France.

E. METHOD

The direct conversational method is most helpful. There is no formal assignment of conversation work in this course because the work is selected especially for the needs in reading and writing. In the oral work of the lesson, however, the instructor must encourage simple, intelligible sentence answers from the students. Constant attention must be given to the correction of "word" answers.

The student should keep a record of the words and sounds presented in each lesson. This notebook can be used to excellent advantage in out-of-class work.

Phonics must more often be caught than taught. The instructor's model must at all times be exceptionally distinct and telling. The review work is most important and must be based on the instructor's record of the special phonic difficulties of the individual student.

Excellent suggestions for instructors in the best methods of conducting phonic lessons may be found in the following books:

1. H. H. Goldberger, "How to Teach English to Foreigners," Public Schools, New York (\$0.75).

2. Ives, "Illustrated Phonics," Longmans, Green & Co., New York.

3. Smith, "Oral English in Secondary Schools, Macmillan." This book will furnish supplementary material for the instructor.

Additional references can be found in the bulletin on "Books for Instructors and Students in Reconstruction Camps, Hospitals, and Schools."

Reading work as outlined will appear to be overambitious during the first lessons. Patience in interesting drill work is essential. The students will soon coordinate the auditory and visual images and will be able to read the unit sentence wholes in a very short time. This type of reading material is an aid in sustaining interest because the sentences appeal to the adult interests of the men.

STANDARDS

A. WRITING

The student should be able to write his name legibly, i. e., with a degree of uniformity in size of letters and in their spacing. He should be able to write the following from dictation:

My name is Private -----

I am a soldier in the United States Army.

I am a patient in General Hospital -----

B. READING

The student should be able to read simple sentences in any standard reader for foreigners of a degree of difficulty equivalent to that in the following lessons in Field & Coveney's "English for New Americans," pages 74 and 78.

C. METHOD OF RATING

The grade of proficiency in writing and reading can be rated by one of the following terms:

(A) Excellent.

(B) Good.

(C) Passing.

(D) Failure.

If definite reports can be made giving accurate measures of attainment for the students completing this course, they will be valuable as showing what can be done by men in such a short, intensive course of instruction. See more advanced courses in English for suggestions as to standard scales and test, some of which may be useful here.

LESSON I

WRITING

(a) Tracing instructor's copy of student's name.

(b) Special study of the formation of the two capital letters in student's name.

(c) Teach the formation of the following small letters:

a, e, d, g, o

PHONICS

Teach—

a—hat.

a—late.

a—about.

ai—raid.

all—called.

In supplying type words for use as illustrations of vowel and consonant sounds in the work in phonics, it is suggested that the instructor select words which appear in the writing and reading for the day, or which are included in the student's vocabulary and are closely related to the lesson topic for the day.

DICTATION

Write lists of new letters taught.

READING

Read:

We are in a hospital.

We come to school every day.

We are learning English.

----- is the teacher.

LESSON II

WRITING

- (a) Trace instructor's copy of pupil's name (at board and desk).
- (b) Special study of the correct formation of those letters in student's name which give the most difficulty.
- (c) Attempt independent copy.
- (d) Teach the formation of:
b, f, h, k, l.

PHONICS

Teach:

e—let.

ee—feet.

ea—seat.

ei—rein.

en—enter.

Extend the list of key words with others chosen from the lesson for the day.

DICTATION

Write lists of letters taught.

READING

- (a) Review Lesson I thoroughly.
- (b) Read:
I am a soldier in the United States Army.
I am a patient in this hospital.
I am in ward -----

LESSON III

WRITING

- (a) Have student trace instructor's copy of his name and attempt an independent copy.
 - (b) Trace this sentence: "I am a soldier."
 - (c) Teach the formation of the following letters: e, i, j, p, s, t.
- Review: a, f, g, k.

PHONICS

Teach:

i—hit.

i—hike.

ie—relieve.

io—lion.

ile—mile.

ill—mill.

Extend the list of key words with others chosen from the lesson for the day.

DICTATION

Write lists of new letters.

READING

(a) Review Lessons I and II.

(b) Read:

I want to be a citizen of the United States.

I must learn to read English.

I can learn to write English in this school.

LESSON IV

WRITING

(a) Have student copy instructor's model of his name. (Save paper for improvement and comparison material.)

(b) Trace the sentence: "I am a soldier in the United States Army."

(c) Teach the following letters: m, n, q, r.

Review: p, j, s, g, b.

PHONICS

Teach:

o—hot.

o—rode.

oa—load.

oi—boil.

ou—round.

mon—money.

Review: a, e, i,

DICTATION

Board and desk work on letters and words learned.

READING

(a) Review Lesson III carefully.

(b) Read:

I am a soldier and a patient in this hospital.

We learn to read and write English in this school.

LESSON V

WRITING

(a) Trace this copy: "My name is Private-----"

(b) Review: "I am a soldier."

(c) Teach the following letters: u, v, w,

Review: d, f, g, q.

PHONICS

Teach:

u—run, fun.

u—ruin.

Review: e, i, o.

DICTATION

(a) Write at desk or board: "I am a soldier in the United States Army."

(b) First 10 letters in alphabet from memory.

READING

(a) Review Lessons III and IV.

(b) Read: "Every good citizen should learn to read and write the English language."

APPENDIX

LESSON VI

WRITING

(a) Trace and copy: "My name is Private....." "I am a soldier in the United States Army."

(b) Attempt the above independently.

(c) Teach the following: x, y, z.

Review: v, w, g, p, s.

PHONICS

Teach:

b—bomb.

d—did.

dr—dry.

f—fall.

h—haul.

j—jaw.

Review: a, e, i, o, u.

DICTATION

Varied tests on these letters: a, b, c, d, e, f, g, h, i, j.

READING

(a) Review: Lesson V.

(b) Read: "The United States, France, England, and Italy are allies in this war."

LESSON VII

WRITING

(a) Trace and copy the following: "United States of America, Italy, England, France."

(b) Teach the following capitals: A, B, C, D, E.

PHONICS

Teach:

k—kick.

l—lame.

m—maimed.

n—nine.

p—pipe.

Review: b, d, f, h, j.

DICTATION

Test and time the writing of all the small letters in the alphabet. (Have record of sample lessons for comparison.)

READING

(a) Review: Lesson VI.

(b) Read:

This..... 19..

(Day of the week)

This is.....

Yesterday was.....

To-morrow will be.....

LESSON VIII

WRITING

(a) Copy the following from the instructor's model: "The United States, England, France, and Italy are allies in the 'World War.' "

(b) Teach the following capitals: F, G, H, I, J.

PHONICS

Teach:

q—quick.
r—roar.
s—sisters.
t—tight.
v—valve.

Review: b, d, f, h, j.

DICTATION

Test and time the writing of all the small letters of the alphabet. (Compare record with previous work.)

READING

We are patients in General Hospital-----

Our address here is—

“General Hospital, -----,”

LESSON IX

WRITING

- (a) Copy from instructor's model: “President Wilson is our Commander in Chief.”
(b) Teach the following capitals: K, L, M, N, O, P.
(c) Review: B, D, G, J.

PHONICS

Teach:

w—win.
x—fix.
y—year.
z—dizzy.

Review: f, k, p, n, l.

DICTATION

Test and time the writing of the small letters of the alphabet. (Compare records on form.)

READING

General Pershing is the commander of the American Troops in France.

LESSON X

WRITING

- (a) Copy from instructor's model: “Every soldier in the United States Army may become a citizen now.”
(b) Teach the following capitals: R, S, T, U, V, W, X, Y, Z.

PHONICS

Teach:

bl—blare.
br—broke.
ch—chest.
cl—clear.
cr—crash.
fl—flood.

DICTATION

Desk and board work in writing parallel columns of small and large letters.

READING

Field & Coveney's "English for New Americans," page 74.

LESSON XI

WRITING

- (a) Copy from instructor's model: An American soldier fights for "World Freedom."
 (b) Copy: 1, 2, 3, 4, 5.
 (c) Review: B, D, G, K, P.

PHONICS

Teach:

gl—glad.
 gr—great.
 ck—back.
 gh—rough.
 ght—right.
 kn—knife.

DICTATION

Test and time written work on parallel columns of small and capital letters.

READING

Field & Coveney's "English for New Americans," page 78.

LESSON XII

WRITING

- (a) Copy from instructor's model:
 The American Army represents the "Right."
 "Right" always triumphs over "Might."
 (b) Copy: 6, 7, 8, 9, 0.

PHONICS

Teach:

ng—hang.
 ou—how.
 ough—plough.
 sh—shot.
 th—thin.
 wh—white.

DICTATION

I am an American soldier.

My name is Private-----

READING

Field and Coveney's "English for New Americans," page 86.

Make as accurate a test as possible of the men's attainment due to this course of study and report it in the records. It will help to make this course more effective for other men who may follow the revised later editions.

READING CARDS FOR UNIT COURSE, ENGLISH I

A. PURPOSE

These cards are similar to "sight reading" cards used in elementary schools. They are intended for rapid drill in reading. There are many ways in which they will be found useful. The key sentence on the back of each card enables the instructor to present the faces of the cards rapidly to the students and know what is being presented, while the cards are

being held with the back to the instructor and the face toward the student. Similar cards can be made for phonic and spelling drills and for comprehension drills. The latter can be very attractive and valuable by making the cards present orders to be obeyed without oral reproduction such as:

Please close the door; Open your book, etc.

B. PREPARATION OF CARDS

Cards suitable for use with men can not be purchased but must be prepared by the instructor as directed under "Equipment." In fact, the greatest teaching value of such devices is found when the subject matter grows out of the particular needs of each group of men. Care must be taken that each sentence be printed in exactly the same form as it is likely to appear in ordinary reading matter. Avoid all diacritical marks and unusual capitalization, underscoring, punctuation, etc.

The record on the back of each card can be conveniently made on a typewriter and pasted on the upper left-hand corner of the large reading card which should be about 6 by 15 inches. The following would be the record on the back of card No. 1:

We are in a hospital.

Assignment 1. Sentence 1

The face of the card will contain nothing but the sentence in large type, "We are in a hospital."

Other cards can be made in the same way for other sentences, phonograms, phonics, orders, or exercises. The following sentences have been suggested in the assignments made in this course:

Assignment 1

SENTENCE 2

We come to school every day.

SENTENCE 3

We are learning to speak English.

SENTENCE 4

----- is the teacher.

Assignment 2

SENTENCE 1

I am a soldier in the United States Army.

SENTENCE 2

I am a patient in this hospital.

SENTENCE 3

I am in ward number -----

Assignment 3

SENTENCE 1

I want to be a citizen of the United States.

SENTENCE 2

I must learn to read English.

SENTENCE 3

I can learn to write English in this school.

APPENDIX

Assignment 4

SENTENCE 1

I am a soldier and a patient in this hospital.

SENTENCE 2

We learn to read and write English in this school.

Assignment 5

SENTENCE 1

Every good citizen should learn to read and write the English language.

Assignment 6

SENTENCE 1

The United States, France, England, and Italy are united in this war.

Assignment 7

SENTENCE 1

To-day is _____, 19--

SENTENCE 2

This day is _____

SENTENCE 3

Yesterday was _____

SENTENCE 4

To-morrow will be _____

Assignment 8

SENTENCE 1

We are patients in General Hospital _____

SENTENCE 2

Our address here is General Hospital, _____

Assignment 9

SENTENCE 1

General Pershing is the commander of the American troops in France.

Rehabilitation monograph. Joint Series No. 5.

Unit Course—English II—Teacher's Manual

BEGINNERS' COURSE IN ENGLISH FOR NON-ENGLISH SPEAKING MEN
LITERATE IN THEIR NATIVE LANGUAGES

January, 1919—Trial edition

A. QUALIFICATIONS OF STUDENTS

This course is intended for those foreign-born students who can read and write in their native language, but who can not read or write in English. These men speak some English badly but understand ordinary everyday conversation and questions very readily.

The simplest test for literacy in the native language is had in questions similar to these:

WRITING

- "Do you get letters from home in Italian (or Polish, Greek, etc.)?"
 "Do you write letters home in your own language?"

READING

- "Can you read these words in Italian (or Polish, Greek, etc.)?"
 "Can you read your newspaper in Italian (or Polish, Greek, etc.)?"

(NOTE.—Use Field and Coveney's "English for New Americans," which contains vocabularies in ten different languages.)

B. AIMS OF COURSE FOR STUDENTS

This course aims to provide the student with such training in reading and writing as will help him to read simple English sentences and to write the facts of his personal history and experiences in simple letter form.

Conversation training can be given in the presentation and practice work in reading. Formal work in conversation is assigned in order to encourage the student to be willing to attempt to talk in English and to allow for the special study of a list of the most common errors in speech.

C. APPROXIMATE TIME TO COMPLETE THE COURSE

This is a 24-hour course, divided into 16 assignments. Each assignment requires 90 minutes, which may be divided as follows:

	Minutes
Conversation	15
Spelling	10
Phonics	10
Penmanship	10
Copying	10
Reading	20
Dictation	15
	<hr/> 90

Each assignment is prepared on the basis of a simple theme or story which describes the facts of personal history and presents experience in a military hospital.

D. NECESSARY EQUIPMENT, BOOKS, AND MATERIALS

- (a) Ruled paper for all written work.
- (b) Soft pencils; stub pens.
- (c) Blackboard space.
- (d) Sight cards as helpful devices for interesting review and drill work.
- (e) One of the following books:
 - (1) Beshgeturian, "Foreigner's Guide to English," World Book Co.
 - (2) O'Brien, "English for Foreigners," Book I, Houghton Mifflin Co.
 - (3) Field and Conveney, "English for New Americans," Silver Burdett Co. (\$0.75.)

SUGGESTIONS TO TEACHERS

The art and science of teaching English to immigrants and the best methods of using the "Direct Conversational Method" in training students to talk English correctly, deserve careful study as a unique teaching problem. No extended elaboration of this work is attempted here. Instructors will profit from the careful study of two recent books on this subject, viz :

- (a) Goldberger, "How to Teach English to Foreigners," H. H. Goldberger, P. S. 18—, New York. (\$0.75).
- (b) "First Steps in Americanization," Mahoney and Herlihy, Houghton Mifflin Co., Boston. (\$0.75.)

The following *pointers* are presented as teacher's helps in presenting each of the subjects outlined under each assignment.

(A) CONVERSATION

The purpose of this work is to encourage the student to talk in English by presenting a subject for discussion which will appeal to his interests and about which he will be willing to talk.

A conversation subject is provided under each assignment. This subject serves as the nucleus around which all the work of the assignment is developed. The evident value of unity under such a plan appeals to the student and assures conscious progress throughout the entire unit course. A theme or short, simple story development is also presented, which serves the dual purpose of providing suggestive conversation material and the content of the writing and spelling lessons.

The instructor solicits answers by clear, simple questions on the theme subject. Invariably the student will answer with one word. Instructors must not be satisfied with such evidences of mere recognition of the meaning of the question. Sentence answers must be required, even if given in simple imitation of the instructor's model. *Insist on sentence answers to every question.* Encourage the student to frame the sentence independently. When this can not be done the instructor must answer the question in correct sentence form and have the pupil repeat it frequently and distinctly. The questions and answers must be written on the board during the development of the theme in conversation.

Paper charts have been suggested as a device which will serve in the place of the black-board and may be kept as a convenient form of record for review work.

The theme subjects assigned are but suggestions as to what any instructor might prepare. The test for such subjects is: "Does this subject suggest experiences which appeal to the student's interests?"

(B) SPELLING

A list of spelling words is selected from each theme for formal study. The standard in choice of spelling words is: "Will the immigrant use this word in his social or personal business letter writing?" Time limitations restrict the work on general spelling lists. Only a comparatively few words can be taught. The Ayres list of 1,000 words is helpful in suggesting the most common words. Make the selection practical. Words are practically chosen for spelling in this unit course if they are words which the immigrant will use in writing.

(C) PHONICS

The choice of phonic sounds for special study must be based on the content of the conversation and reading lessons.

The phonic lists in the first six lessons, however, cover in review form the fundamental sounds and combinations as outlined in Unit Course, English I. The lists selected for each assignment are *not inclusive*. No course in phonics can meet all the varying needs of the individual students of several nationalities. Each immigrant must receive special help for his particular difficulties. The lists presented may be considered as the minimum requirement and do not cover the whole range of fundamental sounds. The instructor must keep a careful record of the individual phonic difficulties of each student.

(D) PENMANSHIP

Ten minutes in each lesson may profitably be spent on the study of penmanship, i. e., correct formation and spacing of letters.

The instructor's aim in this work must not be overambitious. These men desire to write legibly. There is no place in this unit course for the study of the finer points in penmanship style. The average immigrant will progress rapidly and to his entire satisfaction if he is taught correct writing position (foot, back, arms, hand, and fingers) and then given practice lesson material. Suggestions for this practice material are available in several of the copy-books now not used generally in teaching children to write. This material is of value with adults, however, who must be taught correct letter formation in a very short space of time.

The following are recommended for use in this course. (Instructors are urged to study the "Suggestions for teachers," which are well stated in the prefaces of both books):

- (1) Smith's "Intermedial Penmanship, No. 3," Macmillan Co., New York.
- (2) Spencer's "Practical Writing, No. 4," American Book Co.

(E) COPYING

Each student should have his own notebook in which he copies the theme of each lesson, the spelling words, and the phonic list words. He likes to have this record in convenient form for out-of-class study. The instructor should comment frequently on the neatness of these notebooks and should mark them occasionally with blue pencil for special excellence.

Devices of this sort are especially helpful and encouraging; rough draft of the copy work should first be made on paper before entering it in the notebook.

(F) READING

Twenty minutes is assigned to the formal reading lesson in which the textbook is used.

The instructor must make a careful selection of the reading lessons in any of the three books recommended. Choose those lessons which offer a simple paragraph development of a subject. Do not waste time on the first 20 or more lessons found in most of the books available. These first lessons generally provide conversation material and are not adapted to the special needs in our problem of reading in this course.

Do not allow any one student to read too much at one time. Train him to read the lesson over silently, to pick out those words which he does not understand and ask for explanation; to select the words which he can not pronounce correctly and, in brief, challenge the greatest self-activity in the reading from the pupil. When he does read aloud, watch for pronunciation, inflection, and "smoothness." Work on one or two sentences. Encourage the student by frequent compliment and correct his oral reading by patient, kindly, animated good model reading. He will improve by drill work in imitation of the teacher's model.

(G) DICTATION

The immigrant enjoys testing work in writing. Interest may be aroused by selecting a student to conduct the dictation lesson when a group is working together. Each lesson should be corrected and occasionally rewritten. The dictation papers should be kept from day to day. They serve as the best record of the pupil's progress and are of interest to the student and instructor alike.

STANDARDS FOR RATING STUDENTS

(A) PENMANSHIP

The Thorndike scale in penmanship can be used to note improvement. Grade 8 may be considered average for students at the completion of this course. If possible make test at the beginning of the course and again at the close. Report these tests in the records. Samples of student's work before and after taking the course will be valuable. The committee on Course of Study, English II, as mentioned in the "Foreword" will welcome reports and samples of student's work. All such reports on this trial course will be helpful in revising this course.

(B) READING

The existing comprehension, vocabulary, and oral reading tests may need revision to meet men's requirements. Instructors who are interested in measuring the progress of the men in this course will profit by examining Thorndike's comprehension and vocabulary tests and Gray's oral reading scale. The former can be secured from Teachers' College, Columbia University, New York City, and the latter from the School of Education, University of Chicago.

ENGLISH FOR NON-ENGLISH-SPEAKING MEN—LITERATE IN NATIVE LANGUAGE

Assignment I

CONVERSATION

Subject: "Who I am?"

Suggestive questions:

What is your name?

What are you doing now?

Where are you?

What is the name of this hospital?

Why are you here? etc., etc.

Theme:

My name is Private -----.
 I am a soldier in the United States Army.
 I am now a patient in General Hospital -----, -----, -----
 I am in ward -----.
 I am receiving treatment for -----.

SPELLING

name	patient
Private	General Hospital
soldier	ward
United States	surgeon
Army	treatment

PHONICS

a—hat	e—let
a—late	ee—meet
a—ahead	ea—seat
ai—raid	ei—rein
all—called	en—enter

PENMANSHIP

Teach the correct formation of the letters in the student's name.

COPYING

Copy theme on paper and in notebook.
 Copy phonic lists.
 Copy spelling words.

READING

(NOTE.—Reading assignments in these lessons will be indicated according to texts as follows:

Book A—Beshgeturian, "Foreigners Guide to English."

Book B—O'Brien, "English for Foreigners," Book I.

Book C—Field & Coveney, "English for New Americans.")

Book A—page 179.

Book B—page 16.

Book C—page 80.

DICTATION

Any four sentences from the *theme*.
 Any five words from spelling list.

Assignment II

CONVERSATION

Subject: "My address."

Suggestive questions:

Do you get letters from home?

What address is on the envelope?

Is the address correct?

Can you write your address as it is on the board?

Who brings the mail to the hospital?

Etc., etc.

Theme:

I like to get letters from my family.
 I received a letter this week from my brother.
 He sent a letter to me last month which I did not receive.
 He did not write the address correctly on the envelope.
 My address here is:

Private _____,
 General Hospital _____,
 _____,

SPELLING

like
 letters
 from
 family

received
 week
 this
 brother

month
 correctly
 envelope

PHONICS

i—hit
 i—bite
 ei—receive
 ile—mile

ill—mill
 o—hot
 o—rode
 oa—load

oi—boil
 ou—round
 on—money

PENMANSHIP

Teach correct formation of letters in student's and instructor's name and address.

COPYING

Copy theme.
 Copy phonics.
 Copy spelling.

READING

Book A—pages 179 and 180.
 Book B—page 23.
 Book C—page 82.

DICTATION

Dictate and correct any five sentences in Theme II, and any two sentences in Theme I.

Assignment III

CONVERSATION

Subject: "Where I have lived."

Questions:

Where were you born?
 In what part of _____ was your home?
 What big city was near your home in the "old country"?
 What work did your father do?
 How long did you go to school?
 How old were you when you left the "old country"? etc., etc.

Theme:

I was born in the country of _____
 I was born on _____, 18____.
 I am now _____ years old.
 I went to school in _____ for _____ years.
 My father worked as a _____ in the old country.
 My father is dead (living).
 My mother is dead (living).
 I left _____ to come to the United States when I was _____ years of age.

APPENDIX

SPELLING

born	twenty	dead
country	thirty	living
now	father	left
years	worked	when

PHONICS

u—run	b—bone	f—fall
u—ruin	d—did	h—haul
Review a, e, i	dr—dry	j—job

PENMANSHIP

Review for individual difficulties the formation of the following letters:

a, c, d, g, o

COPYING

- 1. Copy theme.
- 2. Copy phonic lists.
- 3. Copy spelling words.

READING

Book A—page 181.
Book B—page 24.
Book C—page 86.

DICTION

Any four sentences in Theme III.
Any five words from I and II.

Assignment IV

CONVERSATION

Subject: "Army experiences."

Suggestive questions:—

- In what town or city were you drafted? (Did you enlist?)
- When did you go to camp?
- Where was this camp?
- What was your company?
- In what other camps and hospitals have you been?

Theme:

I joined the Army on the _____ of _____, _____
I was inducted into service on _____, 191____.
I was assigned to Company _____, _____ Regiment _____
This camp is located in _____, _____.
I stayed here for _____ weeks.
I was transferred to _____, _____.
I have been in the following camps and hospitals _____

I came to this hospital on _____, 19____.
I have been here for _____ weeks.

SPELLING

joined	assigned	camps
city	Company	hospitals
town	Regiment	_____ (State)
State	following	_____ (State)

PHONICS

k—kick
l—late
m—maimed
n—nine

p—pipe
q—quick
r—roar
s—sisters

t—tight
v—valve

PENMANSHIP

Review for individual difficulties the formation of the following letters:

b, f, h, k, l
A, B, C, D, E

COPYING

1. Copy theme.
2. Copy spelling words.

READING

Book A—page 183.
Book B—page 34.
Book C—page 92.

DICTATION

Any three sentences in theme.
Any eight review spelling words.

Assignment V

CONVERSATION

Subject: Why I am in the hospital.

Suggestive questions:

What ward are you in?
What is the ward surgeon's name?
What treatment are you receiving?
How long have you been in the hospital?
How much longer do you expect to be here?

(NOTE.—The instructor should know the clinical history of each student before he attempts any instruction. Care must be exercised in avoiding any unnecessary or improper questioning about the student's ailment or disability. The facts of the case are a matter of record and can generally be ascertained through the Reconstruction Office.)

Theme:

I am receiving treatment which will help to cure me of _____ (adapt to special cases).

I am now in ward _____

The ward surgeon's name is _____

We have medical inspection every morning at 9.

(Select sentence describing the treatment for the individual student.)

SPELLING

receiving
treatment
which
help

cure
every
ward
surgeon

name
medical
inspection
morning

PHONICS

w—win
x—fix

y—year
z—dizzy

Review: a, e, i, o, u.

PENMANSHIP

Review the formation of the following letters in order to detect individual difficulties:

e, i, j, p, s, t
E, F, G, H

Copy simple review theme sentences from instructor's model. Look for uniformity in letter size.

COPYING

1. Copy theme.
2. Copy phonics.
3. Copy spelling words.

READING

Book A—page 184.
Book B—page 35.
Book C—page 95.

DICTATION

Any three sentences in theme.
Any ten review spelling words.

Assignment VI

CONVERSATION

Subject: "Home."

Suggestive questions:

Where were you born?
When did you come to the United States?
Where did you live?
What is your home address now?
Are you married?
With whom did you live?
Have you any brothers or sisters in this country?
What are their names?
Where do they live?
Will you go back to ----- when you are discharged?

Theme:

I was born in -----, on -----, 18-----.
I landed in this country in New York (Boston, etc.) on -----, 19-----.
I went to live with my friends in -----.
My home address now is ----- Street, -----.
(Other sentences stating simplest facts of family ties of the individual student.)

SPELLING

landed	live	address
country	wife	brothers
New York	friends	sisters
went	home	cousins

PHONICS

bl—blare	cr—crash	gr—great
br—broke	kn—knife	ck—back
ch—chest	fl—flood	gh—rough
cl—clear	gl—glad	ght—right

PENMANSHIP

Review the formation of the following letters in order to detect individual difficulties:

m, n, q, r
I, J, K, L

Copy from instructor's model:

"Every soldier must obey orders."

COPYING

1. Copy theme.
 2. Copy phonics.
 3. Copy spelling words.
- Study review lists.

READING

Book A—page 185.

Book B—page 36.

Book C—page 96.

DICTATION

Any three sentences from theme.

Any ten review words.

Assignment VII

CONVERSATION

Subject: "My job."

Suggestive questions:

Where were you working before you joined the Army?

What was the name of the concern?

What did they make?

How long had you worked for this concern?

Did you like this work?

How much did you earn?

What were your chances for getting a better job with more pay?

Will you earn more money if you can speak, read, and write English?

Theme:

I worked as a _____ before I joined the Army.

This shop is in the _____ of _____.

The name of the concern is "_____ Co."

They made _____ and _____ and _____.

I worked for this concern for _____ years.

I was earning _____ dollars a week.

I would not like to go back to this shop.

I can get a better job if I learn to speak, read, and write English.

SPELLING

worked

concern

made

would

before

name

years

like

joined

speak

week

read

shop

write

dollars

English

PHONICS

gl—glad

wh—white

th—there

ng—hang

wh—where

th—with

ow—how

sh—shot

ough—plough

th—thin

PENMANSHIP

Review the correct formation of the following letters in order to detect special difficulties of individual students:

u, v, w, x, y, z

M, N, O, P

Copy from instructor's model:

"General Pershing is the head of the American Army in France."

37046—27—25

COPYING

1. Copy theme.
2. Copy phonics.
3. Copy spelling words.

READING

Book A—page 187.
 Book B—page 37.
 Book C—pages 101 and 102.

DICTATION

Any three sentences in theme.
 Any ten review words.

Assignment VIII

CONVERSATION

Subject: "Reconstruction opportunities."

Suggestive questions:

What were your chances for getting a better job before you joined the Army?
 Would you have had a better job if you had known English?
 Would you have earned more money if you had known how to repair an automobile?
 Would you like to learn how to manage a farm?
 Do you know that you can learn about these trades in this hospital? (Printing, telegraphy, etc.)

Theme:

The Army will help me to earn a good living after I am discharged.
 I can get this help from the Reconstruction Service.
 I can learn how to talk, read, and write good English.
 I can learn about a new trade here.
 I can learn more about my old trade.
 The trades taught in the Reconstruction Service here are: Automobile work, printing, electrical work, drafting, telegraphy, farming, etc.
 I will get well quicker by doing some work in Reconstruction.

SPELLING

Army	discharged	English
help	Reconstruction	quicker
earn	education	trades
living	learn	taught

PHONICS

h—help	tion—Reconstruction	pr—printing
ch—discharged	ght—taught	phy—telegraphy

PENMANSHIP

- (a) Free arm exercise (two-space ovals).
- (b) Teach correct formation of these capitals:

Q, R, S, T, U, V, W, X, Y, Z

COPYING

1. Copy theme.
2. Copy phonics.
3. Copy spelling words.

READING

Book A—page 190.
 Book B—page 39.
 Book C—page 104.

DICTATION

Any four sentences in theme VIII.

Any two sentences in theme VII.

Assignment IX

CONVERSATION

Subject: "A better job."

Suggestive questions:

What work were you doing before you joined the Army?

How much did you earn in a week?

How much did the foreman earn?

Did the foreman speak English?

Could you ever be a foreman if you did not know English?

Would you like to learn a new trade?

Theme:

I must speak good English to get a good job.

I must read and write English.

I can learn English in the Reconstruction school.

I can go to evening school also when I am discharged.

I must know English and arithmetic to get a job as a foreman.

We have many good opportunities for education in the United States.

SPELLING

must

speak

good

English

write

Reconstruction

school

discharged

know

foreman

opportunities

education

PHONICS

st—must

sp—speak

wr—write

sch—school

ch—discharged

kn—know

Select five phonic combinations from the reading lesson.

PENMANSHIP

(a) Free-hand movement:

One-space ovals.

Two-space ovals.

(b) Smith's "Intermedial Penmanship," book 3, page 1.

Spencer's "Practical Writing," book 4, page 1.

COPYING

1. Copy theme.

2. Copy phonics.

3. Copy spelling.

READING

Book A—page 193.

Book B—page 43.

Book C—page 103.

DICTATION

Dictate any five sentences of Theme IX.

Study Theme VI. Dictate any two sentences.

Assignment X

CONVERSATION

Subject: "Ward regulations."

Suggestive questions:

Who is the officer in charge of your ward?

What must you do if you wish to go to town?

Theme:

Every patient in a military hospital is under military discipline.
 Each patient receives his orders from his ward surgeon.
 Military orders must be obeyed here just as carefully as in a camp.
 No patient is allowed to leave the grounds without a pass.
 We must get up at 7 o'clock in the morning.
 We must be in bed at 9 o'clock at night.

SPELLING

patient	military	hospital
discipline	receives	orders
surgeon	obeyed	carefully
allowed	leave	without

PHONICS

tient—patient	gr—grounds
sc—discipline	th—without
st—must	cl—o'clock
geon—surgeon	(Five sounds from reading lesson.)

PENMANSHIP

- (a) Free-hand writing movements:
 Two-space ovals.
 One-space ovals.
- (b) Smith's "Intermedial Penmanship," book 3, page 2.
 Spencer's "Practical Writing," book 4, page 2.

COPYING

1. Copy theme.
2. Copy phonics.
3. Copy spelling words.

READING

Book A—page 195.
 Book B—page 44.
 Book C—page 106.

DICTATION

Five sentences in Theme IX.
 Two sentences in Theme IV.

Assignment XI

CONVERSATION

Subject: "Mess hall."

Suggestive questions:

- Where do you eat your meals?
 Where is the mess hall?
 How many men can eat at one time?
 What did you have for breakfast?

Theme:

All the patients who are able to walk eat in the mess hall.
 The men sit at long tables.
 The food is served to us in large dishes.
 An officer inspects the mess every day.
 The tables and dishes are always very clean.
 The food is good and we have plenty to eat.

SPELLING

able	sit	large	every
walk	tables	dishes	always
eat	food	officer	plenty
mess hall	served	inspects	have

PHONICS

ess—mess	rge—large	all—hall	ea—clean
ng—long	sh—dishes	cl—clean	off—officer

PENMANSHIP

(a) Free-hand writing:

One and two space ovals.

(b) "Intermedial Penmanship," book 3, page 5, or
"Practical Writing," book 4, page 4.

COPYING

1. Copy theme.
2. Copy phonics.
3. Copy spelling.

DICTATION

Any five sentences in Theme XI.
Any two sentences in Theme II.

Assignment XII

CONVERSATION

Subject: "Breakfast."

Suggestive questions.

(Similar in form to those of previous assignments.)

Theme:

We report at the mess hall for breakfast every morning at seven-thirty.
We have many different kinds of food for breakfast.
Fruit, cereal, eggs, coffee, milk, butter, and bread are served.
Our food is always good.

SPELLING

breakfast	kinds	coffee
served	fruit	milk
seven-thirty	cereal	good
different	bread	butter

PHONICS

br—break	th—thirty	br—bread
st—fast	nd—kind	lk—milk
rv—served	fr—fruit	tious—nutritious

(Any five phonic sounds from reading.)

PENMANSHIP

(a) Free-hand writing:

Oval drills.

(b) "Intermedial Writings," book 3, page 10, or
"Practical Writing," book 4, page 11.

COPYING

1. Copy theme.
2. Copy phonics.
3. Copy spelling words.

Book A—page 196.
 Book B—page 48.
 Book C—page 108.

READING

DICTATION

Any five sentences in Assignment XII.
 Any two sentences in Assignment I.

Assignment XIII

CONVERSATION

Subject: "Dinner."

Suggestive questions:

(Similar to those in previous assignments soliciting answers similar to the sentences of the following theme.)

Theme:

Dinner is served at twelve o'clock noon.

We have soup, meat, vegetables, and dessert for dinner.

The meats are beef, lamb, veal, pork, and chicken.

The soups are made from meat and vegetables.

Some of the vegetables are: Beans, peas, corn, cabbage, tomatoes, potatoes, onions, and beets.

The desserts which we have most often are pudding and ice cream.

SPELLING

twelve	tomatoes	chicken
vegetables	ice cream	onions
cabbage	soup	often
pudding	beef	potatoes
dinner	lamb	dessert

PHONICS

in—dinner	cl—o'clock	rk—pork
rv—served	ea—meat	eg—vegetables
tw—twelve	ee—beef	egg—egg

Any five sounds from the reading lesson.

PENMANSHIP

(a) Free-hand writing movement:

One and two space ovals.

(b) "Intermedial Penmanship," book 3, page 15, or
 "Practical Writing," book 4, page 13.

COPYING

Copy theme, phonics, spelling.

DICTATION

Any five sentences in Theme XIII.

Any two sentences in Theme III.

READING

Book A—page 198.
 Book B—page 50.
 Book C—page 110.

Assignment XIV

CONVERSATION

Subject: "Supper."

Suggestive questions:

(Select those which will help to elicit answers similar to the sentences in this theme.)

Theme:

We eat supper every night at five-thirty.

We have good bread and butter at every meal.

We have cold meat or a stew for supper.

Some of the following fruits are served at supper: Prunes, peaches, apricots, or apple sauce.

We digest our food well when we chew our food slowly.

SPELLING

supper	following	digest
prunes	peaches	chew
every	apple	slowly
cold	sauce	
stew	apricots	

PHONICS

up—supper	ld—cold	au—sauce
ght—might	ea—meat	ch—chew
y—generally	ew—stew	sl—slowly

Any five sounds from the reading lesson.

PENMANSHIP

(a) Free-hand writing:

Oval drills (note improvement in uniformity).

(b) "Intermedial Penmanship," book 3, page 17, or
"Practical Writing," book 4, page 14.

COPYING

Copy theme, spelling, phonics.

READING

Book A—page 201.

Book B—page 51.

Book C—page 112.

DICTATION

Any five sentences in Theme XIV.

Any two sentences in Theme X.

Assignment XV

CONVERSATION

Subject: "Red Cross House."

Suggestive questions:

(Leading questions on thoughts suggested in following theme.)

Theme:

The Red Cross House is always pleasant and cheerful.

We can write our letters in this building.

The Red Cross men and women are glad to help a soldier when he is in trouble.

We can play cards and pool in the Red Cross House.

There is always good music being played.

The evening entertainments are very enjoyable.

SPELLING

Red Cross	write	trouble
house	letters	pool
always	building	music
pleasant	women	entertainment
cheerful	glad	

PHONICS

cr—Cross	wr—write	ou—trouble
ou—house	ui—building	oy—enjoyable
ea—pleasant	lp—help	

Any five difficult sounds from reading.

PENMANSHIP

- (a) Free-hand movement:
Oval drills (note improvement).
- (b) "Intermedial Penmanship," book 3, page 20, or
"Practical Writing," book 4, page 16.

COPYING

Copy theme, phonics, spelling.

READING

Book A—page 208.

Book A—page 55.

Book C—page 150.

DICTATION

Five sentences from Theme XV.

Five sentences from Theme XIII.

Assignment XVI

CONVERSATION

Subject: "The canteen."

Suggestive questions:

(Questions should suggest answers similar to the following sentences.)

Theme:

Every Army post has a canteen.

The canteen is a store in which the soldier can buy everything he needs.

The canteen is managed by Army men.

The goods are sold at a low price.

We buy ice cream, cake, pie, smokes, tonic, and candy at the canteen.

We can buy stationery and toilet articles at the canteen also.

SPELLING

canteen	store	managed	cakes
every	which	price	smokes
Army	buy	ice cream	candy
post	every	pies	

PHONICS

st—store
wh—which

th—thing
ld—sold

pr—price
th—there

Any five difficult sounds from the reading lesson.

PENMANSHIP

- (a) Free-hand movement exercises:
Oval drills (note improvement in form).
- (b) "Intermedial Penmanship," book 3, page 21, or
"Practical Writing," book 4, page 18.

COPYING

Copy theme, phonics, spelling.

READING

Book A—page 210.

Book B—page 68.

Book C—page 159.

DICTATION

Any five sentences in Theme XVI.

Any two sentences in Theme XIV.

Rehabilitation monograph. Joint Series No. 6.

Unit Course—English III—Teacher's Manual

ADVANCE COURSE IN ENGLISH FOR FOREIGN-BORN MEN LITERATE IN
THEIR NATIVE LANGUAGES

January, 1919—Trial edition

QUALIFICATIONS OF STUDENTS

This unit course is intended for those men who were born in non-English speaking countries but who have lived in this country for several years. Their ability in English measures up to the following standards:

(a) Oral English: These men speak English readily though inaccurately. They understand very well and will tell the facts of their social, educational, and economic history without diffidence even though the form of their speech is ungrammatical.

(b) Reading: These men can read simple narrative and descriptive English paragraph with a good appreciation of the content but in a halting style and generally weak in pronunciation.

(c) Writing: These men are willing to attempt to write a social letter which will show some appreciation of sentence structure, but which will contain many errors in spelling, capitalization, and punctuation.

These men are ambitious by nature, eager to learn, and generally have attended evening schools or have done considerable independent work in the study of English. They are excellent student material and deserve considerable individual attention in the selection and adaptation of their school work to their special life interests. Such men are often qualified by native talent to be foremen and superintendents.

AIMS OF COURSE FOR STUDENTS

(a) Oral English: Training in oral English must be concerned with the correction of individual errors in speech and abundant practice in conversation on topics which appeal to their interests.

(b) Reading: At the end of the course these men should be able to read the newspaper intelligently and intelligibly.

They should have an appreciation of several good books in history and civics, and a desire for further reading of several good monthly publications on topics of current interest.

They should be able to read a paragraph aloud in such a way as to show that they understand sentence structure, the elements of simple expression, and the correct pronunciation of our most common words. The native accent of his own language will not be entirely removed but should be minimized as much as possible.

(c) Written English:

1. Form: The student should write freely and legibly on completing this course.
2. Spelling: He should know the most common words and should have acquired an appreciation of the value of the dictionary habit. He should know the accepted forms of simple, social, and personal business letters and should be able to write a fairly good letter on suggested topic of interest.

(d) Civics and history: The student should know the fundamental facts in the history of his adopted country. He should be able to interpret the "American idea" from the study of the lives of our national heroes. He should be able to appreciate the privileges of American citizenship as typified in explanations of daily experiences—clean streets, public schools postal service, etc. He should be thoroughly familiar with the reasons why America entered this war, and should be taught why the draft law was fair to all and a typical expression of the responsibility of the American citizen to do his part for the common good.

TIME REQUIREMENTS

Each assignment of this unit course will require 90 minutes for the average student. The following schedule of subjects and time allotments under each assignment is merely suggestive. The time schedule must be adjusted to the student's circumstances.

(a) Conversation.....	20 minutes
Personal history.	
Oral reproduction of historical stories.	
Practical civics discussion.	
Common errors in speech.	
(b) Phonics.....	10 minutes
(Selected from reading and from list of individual difficulties.)	
(c) Written English.....	20 minutes
Penmanship.	
Social letters.	
Personal business letters.	
Reproduction.	
(d) Spelling—Dictation—Dictionary study.....	20 minutes
(e) Reading.....	20 minutes
Books.	
Newspapers.	
Magazines.	

EQUIPMENT

Ruled paper.

Soft pencils.

Stub pens.

Penmanship books (suggested list):

- (a) Smith's Intermedial Penman, Books 5 and 6, Macmillan Co., New York.
- (b) Spencer's Practical Writing, Books 6 and 7, American Book Co., New York.
- (c) Palmer Penmanship Book, A. N. Palmer Co., New York.

Reading books:

- (a) O'Brien's English for Foreigners, Book II, Houghton Mifflin Co., New York.
- (b) Chancellor's Reading and Language Lessons, American Book Co., New York.
- (c) Sharpe's Plain Facts for Future Citizens, American Book Co., New York.
- (d) Hill and Davis' Civics for New Americans, Houghton Mifflin Co., New York.
- (e) Turkington's "My Country," Ginn and Co., New York.

METHODS

The following suggestions are offered for the guidance of the instructor in each of the subjects outlined:

(a) Conversation: These students experience no difficulty in expressing their needs or opinions in English. Their diction is poor, however, and the instructor must appeal to immediate personal interests to awaken a desire for more correct expression. Such interests may be the man's personal pride in correct speech because it is distinguishing, or the man's ambition to speak correct English as an asset in securing a better position. These interests must be reached because the average student of this type does not sense the real need for training in oral English as keenly as the beginner. The conversation work in the course is outlined as follows:

1. Subject.
2. References.
3. Common errors.

It would not be possible to detail the conversation lessons in theme form as has been done in Unit Courses Ia and Ib. The instructor does not have to adhere so strictly to the "theme" idea—formally stated and developed. The conversation work, however, must be developed around one central topic. Otherwise the work will be aimless, irrelevant, and of less lasting value to the pupil.

The references stated under assignments 9, 10, 11, 12 are supplementary reading suggestions for the instructor. Some of this reading material may not be adapted to the special abilities or interests of certain students. The instructor must make a selection which will fit the individual case. The standards for this selection are:

1. A content which will appeal to the interests of an adult man.
2. A form which will be simple enough for the elementary abilities of these students.

COMMON ERRORS OF SPEECH

The common errors of speech noted under each assignment are presented as suggestive material for this type of work. The instructor must exercise extreme caution in the use of these ungrammatical phrases and sentences. Individual errors in speech must form the basis of work of this type. Do not present to the student in formal exercise study any *incorrect* form which he *has not* used. The correct form must be taught in interesting drill exercises.

For suggestions in the teaching of this type of language work consult—

1. Charter's Teaching the Common Branches, page 90. Houghton Mifflin Co.
2. H. H. Goldberger, How to Teach English to Foreigners.
3. Mahoney's Standards in English. World Book Co.

(b) Phonics:

Difficulties in pronunciation are corrected and clinched by selected phonic drills on the troublesome sounds. Each assignment offers a list of phonics which are most commonly considered difficult.

The instructor must supplement this list with the combinations which he has recorded as needing study by the individual student.

(c) Written English:

Penmanship: These men are generally anxious to make special improvement in their penmanship. Three penmanship manuals have been noted in the equipment list. The instructor must decide which type of penmanship work will benefit the student most. Some men will be helped by work of the "copy-book" style, others will advance more rapidly by the training outlined in the strict muscular-movement systems. The copy books are recommended solely because of the expediency in their use. No arbitrary decision in favor of either system can be made to cover every case. Regardless of method, see to it that the student improves the legibility and free control of his handwriting.

SOCIAL LETTER WRITING

These students are accustomed to write letters home in their native language. The instructor must make tactful suggestions as to the possibilities for letters in English to their families, friends, former employers, etc. The fundamental principle for all letter writing is, of course, that the writer tell some things which will be of real interest to the recipient of the letter. The friends of the disabled soldier in a military hospital are all keenly interested in learning from him the facts of his condition, improvement, and the details of his daily experiences in the hospital. Many of these experiences may seem to be more or less trite to instructor and student. Both must try to put themselves in the place of a mother, sister, sweetheart, or friend, and the writing of letters becomes much more interesting. The student should be allowed to make a preliminary rough draft of his letter which the instructor must correct, constructively criticize, and develop. The student should be encouraged to make his final copy a model of correctness in penmanship and form.

The personal business letter will naturally be developed around such situations as: (a) Letter of application for a position. (b) Letter of acceptance or nonacceptance of an offer of a position. (c) Letter to a mail-order house for articles of food and clothing.

The importance of correct form in business-letter writing must be taught thoroughly in abundant exercises.

(d) Reading:

The instructor should have the several textbooks recommended for this unit course at his disposal. The aim in reading work must include the notion that these students need and benefit from a variety of books of the type which will appeal to their interests while in the hospital and will hold over in independent reading later.

Time limitations will require a most careful selection of reading lessons from the books recommended.

A suggestive program is offered in the course outline under each assignment. The instructor may use these at his own discretion. The student should be urged to do considerable reading outside of class and he is generally very glad to do so. Arrangements

may be made by the librarian of the American Library Association to provide the men with copies of each book. Vocational bulletins issued jointly by the Surgeon General's Office and the Federal Board for Vocational Education will offer good material for reading and conversation.

The instructor must read considerably to the class. This practice is valuable in training the pupil's ear to the niceties of correct English expression.

The student must be encouraged to ask questions about the meaning of those words and sentences which he does not understand. Newspaper reading is both interesting and helpful. The instructor must arrange to have copies of the daily papers in class. The progress will be slow at first, but interest can be maintained by a careful selection of the reading. News items should be read and explained. Later, work may be done with the readings and discussions of the editorials.

Some reading might well be attempted in publications such as *Leslie's Weekly* and the *Literary Digest*.

The dictionary habit must be taught under these conditions of real needs. Too little attention is generally given to this necessary training in the use and understanding of dictionary helps.

(e) Spelling:

The Ayres Word List is recommended as a basal list of words for these men. Much work on the study of spelling will have to be done outside of class. The words in the word lists, while being those likely to be used in the language topic for that lesson, have also been selected from reliable lists of words most commonly used in everyday life. Almost all of the words in the spelling lists are found in Ayres 1,000 words.

Review lists of words in any of the common spelling textbooks of the fifth, sixth, and seventh grade may be used with discretion. The student should keep his personal list of spelling words for reference and study.

STANDARDS

(a) Conversation:

Rate a student's ability excellent, good, fair, or poor on the following:

1. Ability to express his opinions on topics of current interest with clearness and correctness in sentence form.
2. Ability to answer in correct sentence form the facts of his social, vocational, and Army experiences.

(b) Written English:

1. Test his penmanship with grade 13 of the Thorndike scale.
2. Test the language of the social letters with the following: Nassau County Supplement to the Hillegas Scale for Measuring Quality of Composition (Quality 3.8).
3. Test his personal business letter with the following: Preliminary Extension of Hillegas Scale (Quality 60).

These scales can be obtained from Teachers' College, Columbia University, New York City.

Assignment I

CONVERSATION

(a) Topic: "My first month's experience in the Army."

NOTE.—The instructor must elicit sentence answers from student, in which he will tell the facts of his enlistment or induction and his first impressions of Army life.

(b) Correct in drill exercises the common grammatical errors of the men, such as: "I done it." "I seen it." "It ain't so." "I have got yet more pain."

PHONICS

(a) Vowel sounds. See O. B. II, page 5.

In this unit course the references to text books are as follows:

- O'Brien's English for Foreigners, Book II: O. B. II.
- Hill and Davis's Civics for New Americans: H. & D.
- Turkington's My Country: Turk.
- Sharpe's Plain Facts for Future Citizens: Sharpe.
- Chancellor's Reading and Language Lessons: Chanc.

WRITTEN ENGLISH

(a) Social letter:

1. Content. Have the student attempt a letter to a friend or relative in which he will describe his present physical condition.
2. Form. Correct; teach proper *heading*.

(b) Penmanship: Practical Writing, book 7, page 1.

(c) Formal study of sentences: See O. B. II, pages 2 and 4.

SPELLING

The spelling lists provided in this unit course are merely suggestive of the kind of words which these students should study. These lists may be considered minimum requirements. The instructor will supplement as fully as the student's ability will allow.

again	arrived	corporal
goes	heard	drilling
using	lieutenant	national
having	captain	fatigue
camp	sergeant	

DICTIONARY WORK

Look up five simple nouns from reading lesson. Teach the sign "n" and its meaning.

DICTATION

Five sentences illustrations of five spelling words.

READING

"Sharpe," page 43:

- (a) Silent reading.
- (b) Explanation of difficult words.
- (c) Oral reading.
- (d) Oral reproduction.

TESTS

If possible, tests of penmanship and language will be very helpful here. See "Standards" in this manual. Such tests should help in guiding the instruction throughout the course, and as a measure of accomplishment when compared with final results.

Assignment II

CONVERSATION

(a) "My job in Army service."

NOTE.—The instructor should aim to develop confidence in the student when he is narrating this and other experiences. Note the most flagrant violations of correct speech, but do not interrupt his story with corrections. The student will not feel free to talk if the corrective criticism is too exacting during the work of the first six or eight assignments.

- (b) Correct in drill exercises the common grammatical errors of the men, such as:
 I come here last year.
 They learn you to speak.
 I am finished of it.

PHONICS

(a) O. B. II, page 78.

(b) Review five phonic sound difficulties in reading of Assignment I.

WRITTEN ENGLISH

(a) Social letter:

1. Content. Have student write a letter to his mother or sister asking for gloves or sweater.
2. Form. Teach correct salutation.

(b) Exercises in correct use of verbs in present tense: O. B. II, page 9.

(c) Penmanship: "Practice Writing," book 7, page 2.

APPENDIX

SPELLING

well	increase	woolen
better	almost	gloves
expect	promise	able
leave	sweater	against

DICTIONARY WORK

Have student look up the meanings of five verbs in reading lesson. Teach the abbreviation "v."

DICTATION

Any six sentence illustrations of spelling words.

READING

Chanc., page 22.

Assignment III

CONVERSATION

(a) "My funniest experience in Army service."

NOTE.—Train for sentence sense, i. e., one thought in one sentence.

(b) Correct in drill exercises the common errors made by the men, such as—

He was to his friend's home.

Can I borry a knife?

PHONICS

(a) O. B. II, page 17.

(b) Any five sounds from reading lesson in II and III.

WRITTEN ENGLISH

(a) Social letter:

1. Content. Have student write a letter to his girl friend thanking her for a box of sweets.
2. Form. Review heading and salutation. Teach proper form of friendly close.
3. Formal study in exercises of regular verbs in past tense. See O. B. II, page 14.

PENMANSHIP—PRACTICE WRITING

Book 7, page 4.

SPELLING

receive	kind	arrived
yesterday	cake	deserve
mail	candy	satisfy
safe	affair	

DICTIONARY

Have pupils look up five adjectives selected from reading. Teach abbreviation and meaning of adjective.

DICTATION

Any six sentence illustrations of spelling words.

READING

Chanc., page 46.

Assignment IV

CONVERSATION

(a) "Why I left the 'Old Country.'"

(b) Correct in drill exercises the common errors made by the men such as—

1. He looked different than me.
2. We bought this by a fruit man.
3. It won't hurt none.

PHONICS

- (a) O. B. II, page 97.
- (b) Any five sounds from reading assignment 4.
- (c) Review phonic lists 1, 2, 3.

WRITTEN ENGLISH

- (a) Social letter:
 - 1. Content. Have student write a letter to his girl friend asking her for her latest photograph.
 - 2. Form. Teach correct spacing for heading and salutation.
- (b) Formal study of the verbs. O. B. II, page 16.
- (c) Penmanship:
 - 1. Two-space ovals.
 - 2. Practice Writing, book 7, page 5.

SPELLING

would	supply	employed
keep	discharged	friend
table	ordered	folks
folks	evening	experience

DICTIONARY

Have pupils look up six words in reading lesson, including nouns and adjectives. Have pupils illustrate these words in sentences in which they are used.

DICTATION

Any six spelling words as illustrated in sentences.

READING

- (a) Chanc., page 81.
- (b) Newspaper reading. Any short news item.

Assignment V

CONVERSATION

- (a) "The job I had before I joined the Army." Train for sentence sense. (One thought in one sentence.)
- (b) Correct in drill exercises the common errors made by the men such as—
 - The book here is tore.
 - Hand me them books there.
 - He was to the doctor.

PHONICS

- (a) O. B. II, pages 5 and 17.
- (b) Select any six sounds in reading in assignment 5.

WRITTEN ENGLISH

- (a) Social letter: 1. Content. Have student write a letter to his girl friend thanking her for her picture.
- (b) Form. Teach capital letters in heading.
- (c) Formal study of use of auxiliary verbs. See book O. B. II, page 23.

SPELLING

picture	afternoon	following
pleasing	evening	sick
expression	because	become
morning	stronger	business

DICTIONARY

- (a) Have students look up the meanings of five adverbs selected from the reading.
 (b) Have students give sentence illustrations of these words from an understanding of their meanings.

DICTATION

Any 20 words from assignments 1, 2, 3.

READING

- (a) "Sharpe," page 50.
 (b) Newspaper reading. Short news items.

Assignment VI

CONVERSATION

- (a) "The job I would like when I am discharged."
 (b) Correct in drill exercises the common errors made by the men such as—
 1. Where are you at?
 2. Leave me see that.
 3. Gimme a pencil.

PHONICS

- (a) O. B. II, page 29.
 (b) Select any five sounds from spelling or reading.

WRITTEN ENGLISH

- (a) Social letter: Have student write a letter to a friend with whom he worked before he entered the Army asking for information about work conditions.
 (b) Drill in correction on sentence sense. (One thought in one sentence.)
 (c) Formal study of nouns. See O. B. II, pages 25 and 31.

SPELLING

returned	getting	citizen
house	hiring	conditions
expect	hope	salary
furlough	change	

DICTIONARY

Have student select three words from reading assignment which he does not understand and which he must learn to explain from independent use of dictionary.

DICTATION

Any six sentence illustrations of spelling words.

READING

"Chanc," page 80.

Assignment VII

CONVERSATION

- (a) "The books which have helped me most." This topic provides excellent opportunities for the instructor in practical suggestions for developing the "library habit."
 (b) Correct in drill exercises the common errors made by the men such as—
 I see him when he done it.
 You wasn't there.
 Joe spoke like he was mad on him.

PHONICS

- (a) O. B. II, page 107.
 (b) Five sounds from reading assignment.
 (c) Review lists in assignments 1, 2, 3.

WRITTEN ENGLISH

- (a) Social letter:
1. Write a letter to a brother telling of the opportunities for reeducation in the hospital and in the schools controlled by the Federal Board for Vocational Education.
 2. Pay special attention to sentence sense and to capitals and periods.
- (b) Formal study in exercises of "pronouns." See O. B. II, pages 48 and 50.

SPELLING

reconstruction	trade	cause
chance	together	district
education	machines	
learn	material	

DICTIONARY

Have students look up synonyms for five spelling words and use them in sentences.

DICTATION

- (a) Any six spelling words illustrated in sentences.
 (b) Any 10 words from spelling lists in assignments 3 and 4.

READING

"Sharpe," page 79.

Assignment VIII

CONVERSATION (REPRODUCTION WORK)

1. Read "The Public Library," H. & D., page 19.
 (NOTE.—The instructor should read slowly and with careful emphasis. The student must be trained to note the main idea in each paragraph. During the first lessons of this type the instructor may find it necessary to have the student reproduce the story paragraph by paragraph.)
2. Correct in drill exercises:
 - (a) Where's them four papers?
 - (b) He wouldn't be left go out.
 - (c) He wouldn't of gone so soon.

PHONICS

1. O. B. II, page 50.
2. Select five difficult sounds from the reading assignment.

WRITTEN ENGLISH

1. Social letter:
 - (a) Have student write a letter to his mother, wife, or sister describing in detail the food which is served to the patients.
 - (b) Correct form; spacing appearance. Drill for sentence sense with capitals and periods.
2. Formal study in exercises of pronouns. See O. B. II, pages 62 and 68.
3. Penmanship: Practical Writing, book 7, page 7.

SPELLING

mess hall	supper	good
served	dishes	weight
breakfast	tables	
dinner	benches	

DICTIONARY

Find synonyms for five spelling words. Teach the use of guide words at top of page.

DICTATION

Any six sentence illustrations of spelling words (by pupils).

READING

"Sharpe," page 205.

Newspaper. Short news items.

Assignment IX

CONVERSATION (REPRODUCTION)

1. The Policeman. See H. & D., page 38.
2. Correct in drill exercises:
 - (a) We were to the canteen.
 - (b) He had kind of a hard time.
 - (c) He uster be over there.

PHONICS

1. O. B. II, Page 107.
2. Select five sounds from spelling and reading.

WRITTEN ENGLISH

1. Personal business letter:
 - (a) Content. Write a letter to your former employer describing present condition and location, and asking for information as to possible reemployment.
 - (b) Study proper salutation of business letter.
2. Formal study in exercises of adjectives. See O. B. II., page 109.

SPELLING

service	disabled	guess
remember	possibility	learn
employ	chance	
wounded	reeducation	

DICTATION

Any six sentence illustrations of spelling.

READING

H. and D., page 38.

DICTIONARY

Have students make lists of difficult words which they must understand to appreciate the reading.

Assignment X

CONVERSATION (REPRODUCTION WORK)

1. The Street Department. Read H. & D., page 49.
NOTE.—After eliciting sentence answers to questions on the reading, the instructor should encourage the student to tell the whole story without interruption or correction.
2. Correct in drill exercises:
 - (a) You was all off on that dope.
 - (b) One of the poles comes down.
 - (c) He must of been late.

PHONICS

1. O. B. II, page 60.
2. Select any six difficult sounds from the reading.

WRITTEN ENGLISH

1. Personal business letter:

(a) Content. Write a letter to the Secretary of the Inquiry Office, Department of Labor, 1706 G Street NW., Washington, D. C., asking for information on work conditions in the student's occupation in his home district and in other sections of the country.

(b) Form. Teach the accepted form of complimentary close in business letter writing.

2. Formal study in exercises on adjectives. O. B. II, page 115.

3. Penmanship. Practice writing, book 7, page 8.

SPELLING

information	know	forget
assistance	expect	willing
help	ready	
find	earning	

READING

H. & D., page 49.

DICTIONARY AND DICTATION

Have student write independently six sentences illustrating six new words requiring use of dictionary.

Assignment XI

CONVERSATION

(a) Reproduction:

1. The Health Inspector. Read H. & D., page 54.

(b) Correction in drill exercises:

1. Why you say that.

2. All them went on a party.

3. I no like to go very much.

PHONICS

(a) O. B. II, page 107.

(b) Review sounds in assignments 4, 5, 6.

WRITTEN ENGLISH

(a) Personal business letter:

1. Content. Write a letter to a former employer accepting the offer of a position.

(b) Form. Teach the paragraph in its simplest form.

(c) Formal study in exercises of adverbs. O. B. II, page 125.

SPELLING

acknowledge	accept	interesting
thanks	discharged	immediately
kind	recovered	
offer	decide	

READING

H. & D., page 54.

DICTATION

(a) Six sentence illustrations of spelling words.

(b) Any 10 words in assignments 4, 5, 6.

Assignment XII

CONVERSATION (DISCUSSION)

(a) Workmen's Compensation. (Type of State legislation.)

(b) Correct in drill exercises:

1. He ought not to of gone.

2. We are glad off it.

3. (Special correction of individual student's slangy expressions.)

PHONICS

- (a) O. B., II, pages 29 and 50.
- (b) Special difficulties in reading.
- (c) Review phonic lists in assignments 5, 6, 7.

WRITTEN ENGLISH

- (a) Personal business letter:
 - 1. Content. Write a letter to the Civil Service Commission asking for information and application blanks for an examination in which the student might possibly be interested.
 - 2. Form. Special attention to arrangement.
- (b) Formal study in exercises of "Parts of Speech," O. B. II, page 126.

SPELLING

Civil service qualification.
Commission experience.
Secretary training.
Information education.
Examination desire.

READING

Turk., page 139. (Constant reference to dictionary as part of the silent reading work which should receive much attention.)

DICTATION

Any six-sentence illustrations of the spelling words.

Assignment XIII

CONVERSATION (DISCUSSION)

- (a) The Army and Navy. (Reference, Turk., p. 320.)
- (b) Correct in drill exercises.
 - 1. They are all sore like on him.
 - 2. What's the matter of you?
 - 3. He don't know nothin.

PHONICS

O. B. II, page 120.
Review lists in assignments 7, 8, 9.

WRITTEN ENGLISH

- (a) Written reproduction of the important points discussed in the oral conversational period on the Army and Navy.
- (b) Formal study in exercises of the possessive case. O. B. II, page 169.

SPELLING

forward	millions	spirit
commander	position	democracy
system	assistance	
thousands	direction	

READING

Turk., page 208. (Use dictionaries.)

DICTATION

- (a) Any six-sentence illustrations of the spelling words.
- (b) Any 10 words selected from assignments 9, 10, 11.

Assignment XIV

CONVERSATION (DISCUSSION)

- (a) Washington: The Father of His Country.
 1. This discussion to bring out the important facts of the birth of our Republic; the causes and effects of the Revolutionary War and the size of the Thirteen Colonies in comparison with our area and population to-day.
- (b) Insist on sentence answers. Encourage by definite directions as to the books out of class work in history.

PHONICS

O. B. II, page 131. Review lists in assignments 9 and 10.

WRITTEN ENGLISH

- (a) Personal business letter:
 1. Content. Write a short letter to the editor of local paper in the student's home town describing very briefly his opportunities for reeducation in the hospital and in the schools controlled by the Federal Board for Vocational Education.

SPELLING

reason	vacation	necessary
interest	whole	system
received	language	
thanking	months	

READING

- (a) O. B. II, page 32. (Directed use of dictionary.)
 (b) Newspaper reading. Editorial comment on news item.

DICTATION

Any five-sentence illustrations of spelling words (provided by students).

Assignment XV

CONVERSATION (DISCUSSION)

- (a) Abraham Lincoln. Discussion to bring out the important facts in Lincoln's life and achievements; his problems in the Civil War; its cause and effects.
- (b) Correct in drill exercises:
 1. He is afraid of go to a doctor.
 2. They were all working to once.
 3. He was there yesterday night.

PHONICS

O. B. II, page 172.
 Review phonic lists in assignments 10, 11, 12.

WRITTEN ENGLISH

- (a) Personal business letter:
 1. Content. Have student write a letter to the Federal Board for Vocational Education, Washington, D. C., asking for information as to the opportunities for special trade instruction in his home State after his discharge from the hospital.
 2. Form. Drill on short sentences which begin with a capital letter and end with a period.
- (b) Formal study in exercises of prepositions. O. B. II, page 201.

APPENDIX

SPELLING

decide	training	settle
cause	expense	willing
heard	tuition	
chances	recommendation	

READING

- (a) O. B. II, page 40. (Directed use of dictionary in silent reading.)
 (b) Newspaper reading. Short editorial comment on news items.

DICTATION

Six sentence illustrations of spelling presented by student.

Assignment XVI

CONVERSATION (DISCUSSION)

President Wilson, the Champion of World Democracy.

(Discussion to bring out the President's leading importance in the world's greatest war and the reasons why the United States entered the war, i. e., "To make the world safe for democracy.")

PHONICS

O. B. II, pages 120 and 131. Review phonics lists in assignments 12, 13, 14.

WRITTEN ENGLISH

(a) Personal business letter:

1. Content. Have the student write a letter to any Mail-order house asking for their catalogues for food and clothing.
2. Form. Special attention to the spacing and arrangement on letter paper and envelope.

(b) Penmanship. Practice Writing, book 7, page 18.

(c) Formal study of simple quotations. O. B. II, page 198.

SPELLING

catalogue.	stockings.	buying.
clothing.	overshoes.	address.
suits.	meeting.	
underwear.	necessary.	

READING

- (a) Turk., page 171.
 (b) Newspaper reading. Editorial comment on some political issue.
 (c) Directed use of dictionary.

DICTATION

Any 20 words in assignments 14, 15, 16.

FINAL TEST

Test the student's penmanship by a standard scale, his composition by Hillegas Scale as suggested and "Standards" in this manual. Report the results in the records. Samples of penmanship and letter composition if sent to the Committee on Course of Study, English III, Division of Reconstruction, Surgeon General's Office, will be appreciated and helpful in revising this course. Before and after records and samples will be doubly valuable.

Rehabilitation monograph. Joint Series No. 7.

Unit Course—English IV—Teacher's Manual

ELEMENTARY WRITING AND READING FOR ENGLISH-SPEAKING ILLITERATES

January, 1919—Trial edition

A. QUALIFICATIONS OF STUDENTS

This course is prepared for use with those men who were born in an English-speaking country but who have never attended school and can not read or write.

The most urgent need of such men is to learn how to write their names and the simplest facts of personal identification. They are also keenly desirous of learning how to read in the shortest possible time. This elementary training in reading must provide them with independent power over the printed page.

B. AIMS OF COURSE FOR THE STUDENT

1. *Writing*.—This course provides such training in writing English as will enable the student to write—

- (1) His name and address.
- (2) His age and place of birth.
- (3) A description of his present status and physical condition in a military hospital.
- (4) The simplest facts of his occupational history.

2. *Reading*.—This course provides the student with such training in reading as will enable him to read simple short sentences, to recognize the fundamental phonic sounds in common words, to know the letters of the alphabet, and to have independent power in recognizing a vocabulary of common words.

C. TIME REQUIREMENT

This course is brief and necessarily delimited to meet the special needs of the English-speaking illiterate.

The course provides 12 assignments, each of which requires at least 75 minutes for instruction, recitation, and directed practice work.

The student is generally willing to do considerable study and practice work out of class, and the instructor should encourage this work by providing simple, definite assignments based on the pupil's individual ability.

Each assignment in this course is divided according to subject matter and time allotment, as follows:

- Reading, 25 minutes.
- Phonics, 20 minutes.
- Penmanship, 20 minutes.
- Copying and dictation, 10 minutes.

D. EQUIPMENT

1. Ruled paper.
2. Soft pencils.
3. Stub pens.
4. Reading cards, viz:

(a) *Purpose*: These cards must be prepared by the instructor as lesson material for the formal teaching of reading to English-speaking illiterates. No primer for young children will suffice.

(b) *Form*: Each assignment provides several short sentences for use in the reading lesson. The instructor must stamp each of these sentences on a strip of cardboard, 6 by 15 inches. A good rubber stamp outfit containing one-half inch letters may be secured from any school supply concern for \$5. The sentences stamped on the cards must be the same, except in size, as the printed sentences in a book. Capitals, small letters, and periods must be used, but no unusual signs, marks, or punctuation.

5. *Textbooks*.—No textbook is to be used during the work of the first eight assignments. The student will be anxious to read from a book and the book work may be started in assignment nine. No textbook is now on the market which is suited to the special needs of this adult student. Primers should not be used on account of the extremely childish appeal of their contents. Good work can be done with a few of the so-called supplementary readers in history, geography, and general science now used in the intermediate grades of the elementary schools. The following are recommended:

- (1) Tappan, "Makers of Many Things," Houghton Mifflin Co.
- (2) Elson and Macmillan, "The Story of Our Country," Book I, World Book Co.
- (3) Blaisdell and Ball, "Hero Stories from American History," Ginn & Co.

6. *Penmanship books*.—(1) Spencer, "Practical Writing," Book III, American Book Co.; (2) Smith, "Intermedial Penmanship," Book II., Macmillan Co. A more extensive bibliography will be found in the bulletin on Books for Instructors and Students in Reconstruction Camps, Hospitals, and Schools.

E. SUGGESTIONS TO TEACHERS

1. *Reading*.—The science and art of teaching elementary reading must receive careful study by the instructor who has had no experience in this work. The following books provide excellent suggestions for the teaching of elementary reading to children:

- (1) Briggs and Coffman, "Reading in Public Schools," Row-Peterson Co.
- (2) Huey, "The Psychology and Pedagogy of Reading," Macmillans, New York.
- (3) Monroe, De Voss and Kelly, "Educational Tests and Measurements," Chapter 3. Houghton Mifflin Co.

The reading lessons in this course are to be presented by a method which combines the accepted "sentence," "word," and "phonic" methods of teaching primary reading. Evidently, no one method which is successful in teaching reading to little children may prove equally successful in teaching reading to an adult man. The difference in mental development between children and men, such as ability to concentrate and to memorize, must be recognized by the instructor. The oral vocabulary of the adult is much larger than that of the child. The adult appreciates the significance of the printed symbols and senses a real need for an understanding of them. No extended elaboration of these psychological distinctions will be presented here.

In general, we may say that the most prominent characteristic of the mental attitude of the adult English-speaking illiterate is the conscious desire for those devices which give him independent power over the printed page. The instructor is constantly faced with the question from the student, "What does this say?" (as he points to a phonic combination or phonogram). This mental trait can be recognized most profitably and the answer is, abundant phonic practice on sounds and combinations carefully organized.

The "sentence," as the natural unit in language, is used as a basis for the reading in the first eight assignments. The card is shown to the student after the instructor has pronounced the sentence. The student recognizes the sentence—whole, even though he can not distinguish the individual words or letters. He is positively desirous of learning the words individually, and these must be taught next. Then he wants to know the letters, and these can best be taught as they occur in the reading sentence.

2. *Phonics*.—The phonic sounds are selected from the reading lesson of each assignment and from an organized list of independent sounds which covers the whole field. Care must be exercised by the instructor in his model pronunciations. The sounds are "caught" more frequently than "taught." A record of the special phonetic difficulties of each student must be kept for review work by the instructor. In fact, review work is most essential for all the sounds, and must be provided in each day's work.

The following books provide excellent material for the understanding and teaching of phonics:

- (1) "Elements of Phonetics," J. M. Dent & Sons.
- (2) Jones, "The Pronunciation of English," Cambridge University Press.

3. *Penmanship*.—The illiterate student is very conscious of his inability to write his name. He is anxious to learn how to write so that he can sign the pay roll, clothing requi-

sitions, etc., and he does want to learn how to write a letter to the folks at home. The problem in this unit course is that of training a man to write the letters of the alphabet in a very short time.

Several conditions, of which extreme time limitation is the most important, require the use of a strictly imitative method for these men learning to write. The instructor may provide the model for each lesson's work. Good results have been secured in this type of work with the use of the copy books now not generally used in school work where adequate time allows for a more careful study of process. But the adult man in the hospital school is conscious of time limitations and demands such training as will result in immediate product. Two copy books are recommended (see equipment list). The extent of their use must be left to the judgment of the instructor.

F. STANDARDS

1. *Oral reading*.—The student should be able to read slowly a paragraph equivalent in degree of difficulty to paragraph 6 of the "Standardized Reading Paragraphs," William S. Gray (School of Education, University of Chicago).

2. *Penmanship*.—The student should be able to write the following sentences with form equivalent to grade 8 on the Thorndike scale (Bureau of Publications, Teachers' College, Columbia University, New York).

- (1) My name is Private -----.
- (2) I am a soldier in the United States Army.
- (3) I am a patient in general hospital -----.
- (4) My home address is -----,

NOTE.—The standards which have been noted above were prepared for use with young people. There exists a real need for similar standards in this type of work with the adult. Any instructor who has had a professional training along these lines is urged to collect and prepare such material from the actual conditions of work, and to submit his conclusions to the Committee on Courses of Study, in re Revision of Standards in Unit Course English IV.

ASSIGNMENT I—(TOPIC: WHERE I AM)

SIGHT READING

I am a soldier.
I am in the Army.
I am in the hospital.
I am in the school.

(NOTE.—Read manual for instructions in presenting this type of elementary reading. Each assignment provides a series of simple sentences which develop a topic. When the ability of the pupil will allow the use of more ambitious sentences, the instructor should present them.)

PHONICS

a—am	I—I
a—army	i—hospital
a—hospital	i—in
e—the	o—soldier
er—soldier	oo—school

PENMANSHIP

1. *Position*.—Teach correct position of feet, back, head, arms, hand.
2. *Hand*.—Teach correct position of the hand; insist on freedom and watch for tenseness; show by demonstration that freedom is necessary for good letter formation.
3. *Student's name*.—Have student trace over the instructor's model copy of the student's name. The first attempts will be slow and laborious. Avoid excessive criticism, but insist on light relaxed condition in student's hand.
4. *Practical Writing*, Book III, page 2; *Intermedial Penmanship*, Book III, page 1.
5. *Alphabet study*.—Teach the student the form and the name of these letters:
a, c, d, g.

6. *Copying*.—Have the student attempt one independent copy of his name in his notebook.

(NOTE.—The instructor should correct this attempt, date the page, and use this first attempt as a basis for comparison in judging improvement in later work. If more ambitious test is possible take a sample of penmanship to be compared with later ones at end of course. Grade both before and after samples on Thorndike or Ayres scales and report the grade in the records. Such reports and samples will be welcomed by the Committee on Course of Study as noted in the "Foreword.")

ASSIGNMENT II—(TOPIC: WHO I AM)

(To be presented on reading cards)

SIGHT READING

I am a soldier in the United States Army.

I am a patient in this hospital.

I shall be paid on the first of the month.

PHONICS

b—be	th—month
p—paid	thi—this
d—United	s—States
t—States	sh—shall

PENMANSHIP

1. *Position*.—Teach correct position of feet, back, head, arms, and hand.
2. *Hand*.—Teach by demonstration the necessity of holding the pencil or pen lightly.
3. *Student's name*.—Have the student trace over the instructor's model copy of the student's name. Have the student attempt an independent copy of the instructor's model.
4. *Practical Writing*, Book III, page 3; *Intermedial Penmanship*, Book III, page 2.
5. *Alphabet study*.—Teach the student the form and the names of these letters:
e, l, b, f

COPYING

Have the student attempt independent copies of his name in his notebook.

ASSIGNMENT III—(TOPIC: BREAKFAST)

(To be presented on blackboards and reading cards)

SIGHT READING

We get up at seven o'clock.

We eat at the mess hall.

The food is cooked by steam.

We use clean dishes.

PHONICS

a—at	ea—eat, steam
e—mess	all—hall
u—up, use	cl—clean, o'clock
y—by	

PENMANSHIP

1. *Position*.—Teach correct position as a necessity for good writing.
2. *Hand*.—Teach by demonstration the advantages of holding the pencil or pen freely.
3. *Student's name*.—Have student copy his name from the instructor's model. Have the student attempt to write his name without the use of a model copy.
4. *Practical Writing*, Book III, page 4; *Intermedial Penmanship*, Book III, page 2.
5. *Alphabet study*.—Teach the student the form and the names of these letters:
h, k, i, j
Teach the student to recite the first 13 letters in alphabetical order.

COPYING

Have the student attempt to write his name in his note book without the use of a model copy.

ASSIGNMENT IV—(TOPIC: GETTING CURED)

(To be presented on blackboard and reading cards)

SIGHT READING

The doctors are fair and kind to us.
A lazy man gets well very slowly.
It is not too late to learn how to read and write English.

PHONICS

a—late	e—gets
a—are	i—English
o—not	i—write
o—doctor	w—well
oo—too	ly—slowly

PENMANSHIP

1. *Position*.—Teach correct position as a necessity and an advantage for good writing.

2. Student's name and present address, viz:

Private -----

General Hospital -----

Have the student trace the instructor's copy of his present address.

3. Practical Writing, Book III, page 5; Intermedial Penmanship, Book III, page 6.

4. *Alphabet study*.—Teach the student the names and form of these letters:

m, n, s, t.

Teach the student to recite the second half of the letters of the alphabet.

COPYING

Have the student trace his copy of the instructor's model of the name and address into his notebook.

ASSIGNMENT V—(TOPIC: RED CROSS HOUSE)

(To be presented on blackboard and reading cards)

SIGHT READING

We like to go to the Red Cross house.
The men can play cards and pool.
We enjoy the shows which are given in the evening.

PHONICS

l—like	pl—play
m—men	c—cards
n—can	g—go
r—red	

PENMANSHIP

1. *Position*.—Train for correct habits in writing position.

2. *Student's name and address*.—Have the student trace and attempt an independent copy of the instructor's model of his name and present address.

3. Practical Writing, Book III, page 6; Intermedial Penmanship, Book III, page 8.

4. *Alphabet study*.—Teach the student the names and forms of these letters:

o, p, q, r.

Drill on correct recital of the letters of the alphabet.

COPYING

Have the student attempt an independent copy of his name and present address in his notebook. (Compare with work in Assignment I.)

ASSIGNMENT VI—(TOPIC: CANTEEN)

(To be presented on blackboard and reading cards)

SIGHT READING

Every camp has a canteen.
Ice cream costs ten cents.
Some candy costs six cents a bar.

PHONICS

h—has	x—six
c—cents	s—costs

Review phonics in Assignments I and II.

PENMANSHIP

Position.—Train for correct habits in writing position.

Student's name and address.—Have the student trace the instructor's copy of his name and home address:

Alphabet study.—Teach the names and form of these letters:

u, v, w, x, y, z.

Drill on the correct recital of the letters of the alphabet.

COPYING

Have the student trace the instructor's model copy of his name and home address in his notebook.

ASSIGNMENT VII—(TOPIC: A LETTER)

(To be presented on blackboard and reading cards)

* SIGHT READING

Our letters come to the post office.
Every soldier enjoys a letter.
I joined this class to learn how to write a letter.

PHONICS

j—joined	oy—enjoys
ow—how	oi—joined
ou—our	

Review phonics in Assignments I, II, III, IV.

PENMANSHIP

Position.—Train for correct habits in writing position.

Student's name and address.—Have the student write his name and home address.
Have the student correct his copy by comparison with instructor's model.

Alphabet study.—Teach the names and forms of these capital letters:

A, B, C, D, E.

Drill on the correct recital of the letters of the alphabet.

COPYING

Have the student copy into his notebook the phonics in Assignments I, II, III, and IV.

ASSIGNMENT VIII—(TOPIC: MY HOME)

(To be presented on blackboard and reading cards)

SIGHT READING

Where were you living last year?
I shall be able to go home soon.
The physician will help to send me home quickly.
I shall laugh when I see my friends.

PHONICS

wh—where	ph—physician
gh—laugh	ng—living
sh—shall	qu—quickly

Review phonic lists in Assignments V and VI.

PENMANSHIP

Have the student write his name and home address and correct to the form of the instructor's model.

Alphabet study.—Teach the following capitals:

F, G, H, I, J.

COPYING

Have the student copy into his notebook the phonic lists in Assignments V, VI, VII, and VIII.

ASSIGNMENT IX

SIGHT READING

Review drill on sight reading work in assignments I, II, and III.

BOOK READING

Select one or two paragraphs from one of the following:

(NOTE.—The instructor must select the most difficult words in any passage for study and explanation of pronunciation before the student attempts any oral reading. The progress in this work will generally be very slow. The aim of the work, however, is to help in developing independent reading power. Much silent study and reading of the passage must be done by the student before he attempts to read aloud.)

1. Story of Our Country, page 77.
2. Makers of Many Things, page 6.
3. Hero Stories from American History, page 77.

PHONICS

Review "lip sounds."

1. Consonants: b, p, m, w, v, f.
2. Vowels: y, u, o.

PENMANSHIP

Position.—Train for correct habits in writing position.

Name and address.—Have the student write his name and home address and correct from instructor's model. Have the student copy from instructor's model the name and address of his nearest relative.

Alphabet study.—Teach the forms of the following capitals:

K, L, M, N, O, P, Q, R.

COPYING

Have the student copy into his note book the phonic lists and illustrations in this assignment.

ASSIGNMENT X

SIGHT READING

Review sight-reading lessons in Assignments IV, V, and VI.

READING FROM BOOKS

Select two or three paragraphs from one of the following texts:

1. Story of Our Country, page 78.
2. Makers of Many Things, page 7.
3. Hero Stories from American History, page 78.

PHONICS

1. Review "tongue sounds," d, t, n, l, r, s, z.
2. Select special phonic difficulties from the reading in the textbook.

PENMANSHIP

Position.—Train for correct habits in writing position.

Name and address.—Have the student write his name and present address, and his name, home address, age, and former occupation, viz:

Private -----
 General Hospital -----,
 -----,
 My name is Mr. -----.
 My address is ----- Street,
 -----,
 My age is ----- years.
 My occupation was -----.

Alphabet study.—Teach the names and the forms of the following capitals:

S, T, U, V, W, X, Y, Z.

COPYING

Copy phonic lists in note book.

Copy the alphabet of capital letters from the instructor's model into note book.

ASSIGNMENT XI

SIGHT READING

Review sight-reading lessons in Assignments VII and VIII.

Word study of sight-reading lessons in Assignments I and II.

READING FROM BOOK

Select two paragraphs from one of the following:

1. Story of Our Country, page 79.
2. Makers of Many Things, page 8.
3. Hero Stories From American History, page 79.

(NOTE.—The instructor must avoid giving the student too much help in this reading. The student must be taught to puzzle out difficult words with his "phonic tools." Do not be disturbed by the small number of sentences which can be read. Train the student for *silent* reading power.)

PHONICS

1. Review "tongue sounds," g, k, j, c, g, x.
2. Select special phonic difficulties from the reading in the textbook.

PENMANSHIP

Position.—Train for correct habits in writing position. Have the student copy and learn the following:

My name is Private

I am a soldier in the United States Army.

I am a patient in General Hospital

Alphabet study.—Have the student write parallel columns of small and capital letters.

COPYING

Copy phonic lists into note book.

Copy penmanship exercise into note book.

ASSIGNMENT XII

SIGHT READING

Review sight reading Assignments I to VIII.

Word study of sight reading lessons I to VIII.

READING FROM BOOK

Select two or three paragraphs from one of the following:

1. Story of Our Country, page 80.
2. Makers of Many Things, page 119.
3. Hero Stories from American History, page 81.

(NOTE.—The student must be taught to refer to the lists of fundamental phonic sounds in his notebook for help in puzzling out difficult sounds.)

PHONICS

Review "tongue sounds," a, e, i, o, u.

Select special phonic difficulties from the reading in the textbook.

PENMANSHIP

Position.—Train for correct habits in writing position. Have the student copy and learn the following:

My home address,

My father's name is Mr.

I worked as a before I joined the Army.

Alphabet study.—Have the student write parallel columns of small and capital letters, and compare with his first written work in his notebook record.

COPYING

Copy phonic lists into notebook.

Copy penmanship exercise into notebook.

(NOTE.—The instructor should test the man's ability in reading and writing as suggested in the Teacher's Manual. Report the ratings of before and after and send samples as requested in "Foreword.")

Rehabilitation monograph. Joint Series No. 8.

Unit Course—Penmanship I—Teachers' Manual

LEFT-HAND WRITING FOR MEN WITH RIGHT-HAND AMPUTATIONS

January, 1919—Trial edition

A. QUALIFICATIONS OF STUDENTS

This course is prepared for a man who has had his right arm amputated and who must be trained to write with his left hand.

The content and arrangement of the course are such as to allow for a flexible adaptation to the varying abilities and needs of individual men. The illiterate or the student with an inferior elementary education will not progress as rapidly nor attempt as ambitious work as the man who has had a thorough elementary or secondary education. This condition is met by providing two sets of exercises in the latter part of the course—one for "beginners" (men with little or no education) and a second set for men who may be classed as "advanced," i. e., men who have had a good common-school education.

Experience with this type of penmanship instruction has shown that there is a much wider variability in the rate of progress of these men in this course than in any other. Some attempt at organization of unit course material is necessary, however. The instructor must adapt the tentative division of the work outlined here to meet the special abilities of each student.

B. AIMS OF COURSE FOR STUDENTS

This course provides instruction material which will train a man to write legibly with his left hand, and with some degree of freedom.

C. TIME REQUIREMENTS

This course provides 24 assignments of introductory and practice material. Each assignment requires 40 minutes for instruction and directed practice.

These men are willing to do considerable practice work "out of class." The instructor should provide the student with the proper writing materials and assignments for such extra work. Care must be exercised during the work of the first ten assignments in preventing wrong habits of writing position, especially the position of the hand.

Ten minutes of each assignment may well be given over to testing exercises. No better incentive for interest and for more intensive work can be provided than that of comparison of the lesson's work with examples of former lessons and with several of the accepted objective standard tests in penmanship.

D. EQUIPMENT

Instruction work in this course requires the use of the following equipment:

1. Large blackboard.
2. Table with smooth surface.
3. Ruled paper.
4. Medium pencils.
5. Stub or ball-point pen points.
6. Thumb tacks.
7. Paper weights.

E. TEACHER'S HELPS

Modern educational psychology on penmanship instruction strongly favors the use of the word and sentence method rather than the so-called "letter method." The worth of the former method is accepted generally for penmanship instruction in which conditions allow of careful training and study of process. Not infrequently in the instruction given to the disabled soldier, conditions of time limitations do not allow of any instruction other than that which is directly concerned with actual product. The student does not have the time nor the slightest desire to specialize on work which requires abundant practice on formal exercises which aim to develop right habits of writing movement. When time limitations and other conditions render the use of any method of writing inexpedient, the instructor should not attempt to force this type of instruction on the student. As a matter of fact,

the adult man will not take it, will lose interest, and will not attend class. A disabled soldier who expects to be discharged in a few weeks must be provided with that type of penmanship instruction which, regardless of method, will train him to write his name and to form correctly the small and capital letters, and the integers.

On the other hand, there are men who realize that they must spend 8 or 10 weeks in the hospital and who are desirous of learning how to write with their left hands with what might be styled "professional" skill. Very often these men are preparing to do clerical work of some kind. The teaching problem with them resembles that in ordinary school work with young people. Attention to method and process as the best preparation for right product is the only sensible procedure under these circumstances.

The choice of the type of instruction best suited to the individual student can be made by the instructor only when he knows the facts of the case for each student. The more important of these facts may be summed up as follows:

1. Educational history.
2. Occupational history.
3. Plans for future vocation.
4. Probable extent of his use of penmanship.

F. BLACKBOARD WORK

The first and most important need of a man who must learn to make his "unused" left arm function in the place of the lost right member is that of training and developing automatic coordination between the muscles and the nerves of his left arm and fingers. The nerves which control these muscles were never used to any great extent on "fine work" when he had his right arm. This sense of absolute control is fundamentally necessary for him now, not only in writing but in the hundred and one movements which he has always unconsciously made with his right hand—e. g., dressing and tying his cravat and shoestrings. Left-hand writing has a direct curative value for this man in developing this sense of control.

The first actions should center around the use of the large movements requiring control. Blackboard work is especially helpful in this regard. The student should be given daily practice in copying or tracing, if necessary, the instructor's model of the common straight line and large oval drills. Considerable friendly encouragement and approval are necessary during the first amateurish attempts. The progress in control is generally rapid, however, and the blackboard work becomes a valuable aid in developing the necessary confidence for further progress.

The first attempts at short word—or letter—formation should also be made at the blackboard and with large letters. The board should be ruled off with large spaces, as the lines are essential for the development of control in letter formation.

G. WORK WITH PENCIL OR PEN

The choice between pencil or pen is generally determined by the student's capabilities. In general, it may be said that the pencil should be used at first by those men who lack all confidence. The pen should be used, however, just as soon as the student is ready for it. The ball-pointed pen point is recommended because it runs more smoothly and is less apt to tear the paper or prevent free movement. The student should be provided with a good fountain pen just as soon as he is able to know which type of pen point is best suited to his needs.

The table on which the writing is done must have a smooth surface; and when the stump of the right arm is so short as to prevent holding the paper firmly, the paper must be held in place by a weight or by thumbtacks.

H. STANDARDS

The best standards for measuring this unique type of penmanship must be selected and prepared from the work of the students themselves. Each instructor is urged to save the copies of the writing of the men at the end of the tenth, fifteenth, twentieth, and twenty-fourth assignments. This material is invaluable for reference data in the establishment of the necessary objective standards for measuring left-hand writing.

The student's writing sheets during the course should be saved in individual folders and referred to frequently for comparison in personal improvement.

Grade 8 of the Thorndike scale is recommended as a tentative standard at the completion of the course.

Samples of penmanship, together with reports of first and final tests, will be very helpful if sent to the Committee on Course of Study as requested in "Foreword."

LESSON I

BLACKBOARD WORK

1. *Exercises for control.*—The instructor must write a line of compact circles 10 inches high on the board. (NOTE.—An instructor should practice writing with his left hand, and considerable proficiency has been developed by instructors engaged in this work. The model for the student must be correct, however, and the instructor should not provide a copy written by his left hand, unless it is uniformly standard in its appearance.) The student will then attempt to make a copy of these circles on a line 10 inches below the model. The first attempts will be extremely poor in form and laboriously drawn. Friendly, cheery criticism, and approval by the instructor are helpful.

2. *Letter form.*—The instructor must write the words: at—add—ago—age on the board in letters which are vertical in form, and from 4 to 5 inches in height.

The student will attempt to write these words on a line 4 inches below the instructor's model.

TABLE WORK

1. *Words.*—The instructor provides the student with a sheet of ruled paper on which are legibly written these words: at—add—age—ago.

The student will attempt to make his copy resemble the instructor's.

2. *Letters.*—When the student has special difficulty with certain letters, the instructor must provide him with a model copy of these letters, which the student will imitate when trying to correct his difficulties and to establish the right habit of the letter formation.

These letters may require special study: a—d—g—o—t.

3. *Exercise.*—The student's name. The man is anxious to learn to write his name first. This may be done in the first lesson. The student should attempt to make his copy resemble the instructor's model.

LESSON II

BOARD WORK

1. Ten-inch circles.
2. Be—bad—bit—body—been.

TABLE WORK

1. Two-space circles. (Avoid excessive back slant.)
2. Copy from instructor's model: be—bad—bit—body—been.
3. *New letters.*—Drill, if necessary, on correct habit in forming b—e—i—y—n.
4. *Exercise.*—Student's name. (Select for drill exercises those letters which cause most difficulty.)

LESSON III

BOARD WORK

1. Copy instructor's model of compact vertical lines 10 inches high.
2. Attempt independent line of 10-inch circles.
3. *New words.*—Call—cab—can—card—candy (written in 5-inch letters).

TABLE WORK

1. Copy instructor's model of two-space circles.
2. Copy instructor's model of these words: call—cab—can—card—candy.
3. *New letters.*—Special study, if necessary, on the correct formation of: c—l—r.
4. Review: d—g.
5. *Exercise.*—Student's name.

LESSON IV

BOARD WORK

1. Copy instructor's model of a line of 5-inch compact circles.
2. *New words*.—Copy instructor's model of these words: face—fill—fool—fear—fun.

TABLE WORK

1. Copy instructor's model of a line of one-space compact circles.
2. Copy instructor's model of these words: face—fill—fool—fear—fun.
3. Attempt an independent copy of: add—body—candy.
4. *Exercise*.—Drill on student's signature.

LESSON V

BOARD WORK

1. Attempt a line of 5-inch compact vertical lines.
2. *New words*.—Copy instructor's model of: hill—his—h o n e chair (5-inch letters).

TABLE WORK

1. One-space compact vertical lines.
2. Copy instructor's model of: hill—his—home—chair.
3. *New letters*.—Drill, if necessary, on correct formation of: h—s—m.
4. Review: c—v—f—u.
5. *Exercise*.—Student's name. Compare with work done in assignments 1 and 2.

LESSON VI

BOARD WORK

1. Attempt a line of 5-inch compact circles.
2. *New words*.—Copy instructor's model of the following words, written with 3-inch letters: joke—job—jaw—jewel.

TABLE WORK

1. One line of one-space circles.
2. One line of one-space vertical lines. (NOTE.—Watch for improvement in uniformity.)
3. Copy from instructor's model: joke—job—jaw—jewel.
4. *New letters*.—Drill, if necessary, on the correct formation of: j—k—w.
5. Review: h—s—l—f.
6. *Exercise*.—Student's name.

LESSON VII

BOARD WORK

1. Copy from instructor's model: One line of compact circles 3 inches high.
2. *New words*.—Put—prove—pity—pipe.

TABLE WORK

1. Write one line of one-space circles and one line of compact vertical lines. (Watch for improvement in uniformity.)
2. *New letters*.—Drill, if necessary, on the correct formation of: p—v. Attempt independently: put—pity—prove—pipe.
3. Review: h—j—k.
4. *Exercise*.—Student's name.

LESSON VIII

BOARD WORK

1. One line of 3-inch circles—30 in a group—four groups.
2. *New words*.—Copy from instructor's model: quick—fix—size—miles.

TABLE WORK

1. Two lines of one-space circles—50 in a group—two groups.
2. *New letters*.—Drill, if necessary, on the correct formation of: q—x—z.
3. Review: p—v—w—r.
4. *Exercise*.—Student's name.

LESSON IX

BOARD WORK

1. Compact circles 3 inches high—30 in a group—four groups.
2. *New words*.—Copy from instructor's model: America—Asia—Alsace—Austria.

TABLE WORK

1. One space compact circles—50 in a group—two groups. (Compare with previous work for improvement in uniformity.)
2. Write: America—Asia—Alsace—Austria.
3. *New letter*.—A.
4. *Exercise*.—Copy from instructor's model: Student's name and present address in a military hospital.

LESSON X

BOARD WORK

1. Compact vertical lines—2 inches high—50 in a group—three groups.
2. *New words*.—United States—General Hospital.

TABLE WORK

1. One space compact vertical lines—50 in a group—two groups.
2. Write: United States—General hospital.
3. *New letters*.—U—S—G—H.
4. *Exercise*.—Copy from instructor's model: Student's name and present address.

(NOTE.—At the completion of the work of this assignment, the instructor and student should make a careful comparison of the grade of penmanship of the exercise in this assignment with that in assignments 1, 4, and 8, to detect improvement. The penmanship of this assignment might then be compared with the lower grade on the Thorndike or Ayres scale. The grade should be noted on the assignment. A higher standard may then be selected as the goal for the grade of penmanship at the end of the twentieth assignment.)

LESSON XI

BOARD WORK

1. Compact circles—two inches high—twenty in a group—five groups.
2. *New words*.—Buenos Aires—Boston—Cleveland—Denver.

TABLE WORK

1. One space compact circles—10 in a group—10 groups.
2. *New words*.—Buenos Aires—Boston—Cleveland—Denver.
3. *New letters*.—B—C—D.
4. *Exercise*.—Study corrections on exercise in assignment 10. Rewrite student's name and present address.

LESSON XII

BOARD WORK

1. Compact vertical lines—2 inches high—20 in a group—five groups.
2. *New words*.—Georgia—Holland—Iowa—Japan—Kansas.
3. *New integers*.—1—2—3—4—5.

TABLE WORK

1. One space compact lines—10 in a group—10 groups.
2. Copy under instructor's model: Japan—Holland—Iowa—Georgia—Kansas.
3. *New letters*.—G—H—I—J—K.
4. *Exercise*.—Student's name and present address.

LESSON XIII

BOARD WORK

1. Movement drills on circles and vertical lines. (NOTE: The instructor must select the special difficulties of each student as the basis for intensive drill of this type.)
2. *New words*.—Liverpool—Maine—New England—New Orleans—Philippines.

TABLE WORK

1. Movement drills on circles and vertical lines to develop speed and free control.
2. Copy from inspector's model short sentences illustrating these words: Liverpool—Maine—New England—New Orleans—Philippines.
3. *Exercise*.—Copy from instructor's model: (a) Father's name, (b) mother's name.

LESSON XIV

BOARD WORK

1. Movement drills on 2-inch circles and vertical lines.
2. *New words*.—Quebec—Russia—San Francisco—Tennessee—Utica.

TABLE WORK

1. Movement drills on one-space lines and circles. Copy 6—7—8—9—10. Short-sentence illustrations of the following words: Quebec—Russia—San Francisco—Tennessee—Utica.
2. Special-review drills on correct formation of the following capital letters: A—B—C—D—E—F—G—H.
3. *Exercise*.—Copy from instructor's model: Parents' names and address.

LESSON XV

BOARD WORK

1. Movement drills on compact 2-inch circles and vertical lines.
2. *New words*.—Vermont—Washington—Xmas—New York—New Zealand.

TABLE WORK

1. Movement drills on one space circles and vertical lines. (Compare with assignments 5, 6, 11, and 12 for improvement. Use comparisons as basis for further intensive drill.)
2. *Special study*—V—W—X—Y—Z.
3. Review for special correction: I—J—K—L—M—N—O—P—Q—R—S—T—U.
4. *Exercise*.—Copy from instructor's model: Former employer's name and address.

LESSON XVI

BOARD WORK

1. Movement drills for speed and uniformity.

TABLE WORK

1. Movement drills selected to meet the special need of the individual.
- A. *Beginners*.—Copy from instructors' model:
 - What is this? This is paper.
 - What is that? That is a wall.
 - What are these? These are pencils.
 - What are those? Those are pens.

B. *Advanced*.—Write a short letter (not more than one paragraph) to his mother telling her that he has been learning to write with his left hand.

Exercise.—Movement drills timed and corrected by the student.

LESSON XVII

BOARD WORK

Movement drills—4-inch spaces—circles and vertical lines. Record time.

TABLE WORK

A. *Beginners*.—Copy from instructor's model:

I hold a pen. I take this pen in my hand. I write my name with this pen. I am learning to write with my left hand.

B. *Advanced*.—Write a letter to a parent describing his daily program in the hospital.

Exercise.—Write and time five lines of small "a's"—five in a group—four groups on a line

LESSON XVIII

BOARD WORK

Movement drills—2-inch spaces—selected to meet special needs for uniformity and control.

TABLE WORK

Movement drill, if necessary.

Review formation of the integers.

A. *Beginners*.—Copy from instructor's model:

I can write well with my left hand. Reconstruction work has helped me.

B. *Advanced*.—Write a letter to a friend asking him to come and visit him at the hospital.

Exercise.—Write and time five lines of small "e's"—five in a group—four groups on a line.

LESSON XIX

BOARD WORK

Movement drills if necessary.

TABLE WORK

A. *Beginners*.—Copy from instructor's model:

Whose chair is this? This chair is used by the teacher. This coat belongs to the instructor. I know that I can improve my writing by practice.

B. *Advanced*.—Write a letter home describing the opportunities in the reconstruction service in the hospital.

Exercise.—Spelling lists of common words selected from the Ayres list.

LESSON XX

BOARD WORK

Movement drills selected to meet the special needs of the individual student.

TABLE WORK

A. *Beginners*.—Copy from instructor's model:

Have you a watch? I have a wrist watch. Does the watch keep good time? This watch does not keep very good time.

B. *Advanced*.—Write a letter to the office of the Federal Board for Vocational Education inquiring about opportunities for further education after discharge.

Exercise.—Test in dictation the sentences taught in assignments 16 and 17.

LESSON XXI

BOARD WORK

Movement drills as required.

TABLE WORK

A. *Beginners*.—Copy from instructor's model:

I am a soldier in the United States Army. I am a patient in general hospital----- I am trying to use an artificial arm.

B. *Advanced*.—Write a letter to a friend with whom he worked before he joined the Army, asking about possibilities of obtaining work.

Exercise.—Compare written work with Thorndike or Ayres scale; grade; note improvement by comparison with work of assignment 10.

LESSON XXII

BOARD WORK

Movement drills as required.

TABLE WORK

A. *Beginners*.—Copy from instructor's model:

I was born in the town (city) of -----, -----, on -----, 18--

I am now ----- years of age. Before I joined the Army I worked as a -----.

B. *Advanced*.—Write a letter to a former employer describing present conditions and asking for information about the opportunities for reemployment.

LESSON XXIII

BOARD WORK

Movement drills as required.

TABLE WORK

A. *Beginners*.—Write a short letter (one paragraph) to his parents telling that he is learning to write with his left hand.

B. *Advanced*.—Write a letter to the secretary of the inquiry office of the Department of Labor in Washington, D. C., asking for information about the opportunities for work for men with a right-arm amputation.

Exercise.—One-space compact circles and vertical lines. Time, and compare with all previous work to show progress.

LESSON XXIV

BOARD WORK

Movement drills as required.

TABLE WORK

A. *Beginners*.—Write a short letter to the Federal Board for Vocational Education, asking for information about the educational opportunities in his home district after discharge.

B. *Advanced*.—Write a letter to the editor of his home paper describing the opportunities for reeducation which he has experienced in a military hospital.

Exercise.—Measure the grade of writing by means of the Thorndike or Ayres penmanship scales, and estimate the improvement for the whole course. Report the grade in the records and in suggestions to the committee on courses of study, as requested in the "Foreword."

Rehabilitation monograph. Joint Series No. 9.

Unit Course—Penmanship II—Instructor's Manual

LEGIBLE HANDWRITING FOR MEN OF INFERIOR ELEMENTARY SCHOOL TRAINING

January, 1919—Trial edition

1. QUALIFICATIONS OF STUDENTS

This course is intended for those men who have had one, two, or three years of elementary school education. These men are able to sign their names but are such bad penmen that they are generally unwilling to write a letter on account of this handicap. Many of them are willing to take some formal instruction in penmanship provided that they know that they are definitely progressing in the work and are not required to specialize on any rigid course which aims at training for what might be styled professional penmanship.

2. AIMS OF COURSE FOR STUDENTS

This course aims to provide the adult (beginner in penmanship) with such exercises in sentence, word, and letter formation as will train him to write legibly with some degree of free movement.

3. APPROXIMATE TIME

Forty minutes is the maximum period of time during which a man of this type may be expected to work continuously at penmanship. The course is divided into 30 assignments which total 20 hours of instruction. The variability in the rate of progress in this course with different men will be very great.

The time assignment is tentative. The instructor must adapt the length of the lesson period and the amount of work laid down under each assignment to the special interests and needs of the individual student.

4. EQUIPMENT

Blackboard, ruled paper, stub pen points. "Practical Writing," Books IV and V, American Book Co. "New graded System of Penmanship," Books IV and V, Charles Merrill Co.

5. SUGGESTIONS TO TEACHERS ON METHOD

Muscular movement writing is generally accepted as offering the best method of teaching penmanship in our schools. The average man with an inferior elementary-school education, however, who has a very limited amount of time for penmanship instruction in hospital schools will not benefit from this type of penmanship instruction. Moreover, his utter lack of experience in penmanship and the probable limited use of it in the future render the use of this method inexpedient. The course is based on the principle that a man of this type needs that kind of instruction in which he will learn to write legibly in the shortest space of time. Very often a student will progress rapidly enough in his course and will make such progress as will warrant further penmanship instruction of the type which emphasizes movement as the fundamental requisite for legibility, plus speed and beauty of form.

The penmanship manuals recommended for use in this course provide excellent teacher's instructions. No elaboration of these is offered here. The instructor who uses this course should study the teaching pointers carefully and base his work on them.

The board work outlined will be valuable to develop full movement and afford the instructor an opportunity to criticize the formation of the letters but the board work is not indispensable. It can be dispensed with if conditions make it convenient. It also has merit as a rest exercise to break long periods of desk practice. In the later lessons of the course it may be wise to shorten the length of the blackboard work or even eliminate it altogether.

6. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

The student who completes the work of this course should be able to present a copy which will compare favorably with that in grade 13 of the Thorndike scale or grade 50 of the Ayres handwriting scale. The use of either or both of these scales by the instructor and student offers the best possible incentive to conscious, definite progress. Careful rating of student's penmanship at the beginning and at the close of this course will be valuable to both student and instructor. Report these first and final ratings in the records. They will be valuable when revising this course. Samples of penmanship showing the progress of the men will be welcome if forwarded with criticism as requested in the "Preface."

It is expected that a student will continue his work in reviewing this course until he is able to present a copy which will measure up to the standards established. The certificate will state that the student has "passed" the work in the course of Penmanship II.

STUDENT'S INSTRUCTION SHEETS

Assignment I

A. BOARD WORK

1. Copy the instructor's model of a line of compact ovals 10 inches high.

B. TABLE WORK

1. Copy instructor's model of the student's name and present address.
2. "Practical Writing," Book IV, page 1; or "Merrill's Penmanship," Book IV, page 1.

Assignment II

A. BOARD WORK

1. Copy instructor's model of a line of compact ovals 4 inches high.

B. TABLE WORK

1. Copy instructor's model of student's name and present address.
2. Special drill exercises on the correct formation of those letters in the signature and address which give the most trouble.
3. "Practical Writing," Book IV, page 2; or "Merrill's Penmanship," Book IV, page 2.

Assignment III

A. BOARD WORK

1. Copy instructor's model of a line of compact ovals 4 inches high and a line of ovals 2 inches high.

B. TABLE WORK

1. Copy instructor's model of a line of two-space ovals.

NOTE.—This exercise is given solely as an aid in the development of freedom in the student's hand.

2. Copy instructor's model of student's name and present address.
3. Special drill exercises on the correct formation of the "troublesome" letters in the name and address.
4. "Practical Writing," Book IV, page 3; or "Merrill's Penmanship," Book IV, page 3.

Assignment IV

A. BOARD WORK

1. Copy instructor's model of 2-inch compact ovals.

B. TABLE WORK

1. Copy instructor's model of a line of two-space compact ovals.
2. Copy instructor's model of student's name, age, and present address.
3. Special drill exercises on the correct formation of the difficult letters in the name and address.
4. "Practical Writing," Book IV, page 4; or "Merrill's Penmanship," Book IV, page 4.

Assignment V

A. BOARD WORK

1. Copy instructor's model of compact ovals, both 4 inches and 2 inches high.

B. TABLE WORK

1. Copy instructor's model of two-space compact ovals.
- NOTE.—Comparisons with the work of Assignment III should be made to detect improvement in uniformity.
2. Copy instructor's model of student's name, age, and present address. Preserve a copy of this for rating and for future comparisons.
 3. Special drill exercises on correct formation of difficult letters.
 4. "Practical Writing," Book IV, pages 5-6; or "Merrill's Penmanship," Book IV, pages 5-6.

Assignment VI

A. BOARD WORK

1. Copy instructor's model of compact lines, 4 inches high.

NOTE.—The instructor should explain to the student that these movement exercises are given for the special purpose of developing freedom and control in the arm muscles necessary in the handwriting at the table.

B. TABLE WORK

1. Copy instructor's model of two-space lines.
2. Copy instructor's model of student's name and home address.
3. Special drill exercises on correct formation of those letters in the home address which give difficulty to the student.
4. "Practical Writing," Book IV, pages 7-8; or "Merrill's Penmanship," Book IV, pages 7-8.

Assignment VII

A. BOARD WORK

1. Copy instructor's model of compact lines 4 inches high.

B. TABLE WORK

1. Copy instructor's model of two-space lines.
2. Copy instructor's model of student's name and home address.
3. Special drill exercises on the correct formation of the difficult letters in the home address.
4. "Practical Writing," Book IV, pages 8-9; or "Merrill's Penmanship," Book IV, pages 8-9

Assignment VIII

A. BOARD WORK

1. Attempt independent lines of compact ovals and straight lines 4 inches high, and straight lines correct according to instructor's model written under the student's attempt.

B. TABLE WORK

1. Attempt independent lines of two-space compact ovals and straight lines.
2. Write independently name and home address.
3. Special drill exercises on the correct formation of the difficult letters in the home address.
4. "Practical Writing," Book IV, review pages 1-10; or "Merrill's Penmanship," Book IV, review pages 1-10.

Assignment IX

A. BOARD WORK

1. Attempt independent lines of 2-inch compact ovals. Correct and rewrite according to teacher's model.

B. TABLE WORK

1. Copy instructor's model of one-space compact ovals and lines.
2. Copy instructor's model of parent's name and address.
3. Special drill exercises on difficult letters in parent's name.
4. "Practical Writing," Book IV, pages 10-11; or "Merrill's Penmanship," Book IV, pages 10-11.

Assignment X

A. BOARD WORK

1. Attempt independent lines of compact lines. Correct and rewrite according to instructor's model.

B. TABLE WORK

1. Copy instructor's model of two-space reversed ovals.
2. Copy instructor's model of brother's name and address.
3. Drill exercises on correct formation of difficult letters in brother's name.
4. "Practical Writing," Book IV, pages 10-11; or "Merrill's Penmanship," Book IV, pages 10-11.

Assignment XI

A. BOARD WORK

1. Copy instructor's model of 2-inch compact reversed ovals.

B. TABLE WORK

1. Attempt independent lines of two-space reversed ovals.
2. Copy instructor's model of sister's name and address.
3. Drill exercise on difficult letters in sister's name.
4. "Practical Writing," Book IV, pages 14-15; or "Merrill's Penmanship," Book IV, pages 14-15.

Assignment XII

A. BOARD WORK

1. Review movement drill.
2. Copy from instructor's model of the following words: *at, do, go, queer*.
3. Special study of these letters: *a, d, g, q*.

B. TABLE WORK

1. Review movement drill.
2. Copy from instructor's model of the student's former employer's name and address.
3. Drill exercises on difficult letters in employer's name.
4. "Practical Writing," Book IV, pages 16-17; or "Merrill's Penmanship," Book IV, pages 16-17.

Assignment XIII

A. BOARD WORK

1. Review movement drill.
2. Write the following words independently and then correct and rewrite according to instructor's model: *at, do, go, queer*.
3. Special study of these letters: *a, d, g, q*.

B. TABLE WORK

1. Review movement drill.
2. Write independently former employer's name and address. Correct and rewrite.
3. "Practical Writing," Book IV, pages 18-19; or "Merrill's Penmanship," Book IV, pages 18-19.

Assignment XIV

A. BOARD WORK

1. Review movement drills.
2. Write the following words independently and then correct with the instructor's model: *cod, ox*.
3. Special study of: *c, o, x*.

B. TABLE WORK

1. Review movement drill.
2. Practice writing former employer's name and address.
3. "Practical Writing," Book IV, review pages 10-19; or "Merrill's Penmanship," Book IV, review pages 10-19.

Assignment XV

A. BOARD WORK

1. Movement drill on 2-inch ovals and compact lines.
2. Write these words: *box, fox, had, kill*.
3. Drill, if necessary, on the correct formation of *b, f, h, k*.

B. TABLE WORK

1. Movement drill on one-space ovals and lines.
2. Copy instructor's model of a letter of application for a position.

NOTE.—Whenever a student is able to compose this letter independently he should be encouraged to do so. The aim in this work is not that of language, however, but of practice in penmanship. Preserve a copy of this for rating and future comparisons.

3. "Practical Writing," Book IV, pages 20-21; or "Merrill's Penmanship," Book IV, pages 20-21.

Assignment XVI

A. BOARD WORK

1. Movement drill, if necessary.
2. Write these words using letters studied in previous assignments: *dog, ago, quick, box, had, knob*.

B. TABLE WORK

1. Movement drill as required.
2. Write a letter of application for a job; correct with instructor's model and rewrite.
3. "Practical Writing," Book IV, pages 22-23; or "Merrill's Penmanship," Book IV, pages 22-23.

Assignment XVII

A. BOARD WORK

1. Movement drills as required.
2. Write these words and correct with teacher's model: *bag, fox, had*.

B. TABLE WORK

1. Movement drill as required.
2. Practice work on a letter of application for a job. (Use newspaper advertisement.)
3. "Practical Writing," Book IV, pages 23-24; or "Merrill's Penmanship," Book IV, pages 23-24.

Assignment XVIII

A. BOARD WORK

1. Movement drill as required.
2. Write these words and correct with teacher's model: *light, lack, fat, job*.
3. Special study, if necessary, on *l, t, j*.

B. TABLE WORK

1. Movement drill as required.
2. Practice work on a letter of application for a job. (Use newspaper advertisement.)
3. "Practical Writing," Book IV, review pages 20-24; or "Merrill's Penmanship," Book IV, pages 20-24.

Assignment XIX

A. BOARD WORK

1. Movement drill as required.
2. Write these words and correct with teacher's model: *tight, fight, load, jacket*.
3. Special study, if necessary, on the correct formation of *l, t, j*.

B. TABLE WORK

1. Movement drill as required.
2. Practice work on a letter of application for a job. (Use newspaper advertisement.)
3. Write and correct with teacher's model the following: *tight, had, knob, fight, lack, dog, kill, load, fat, ago, cod, jacket, job, quick, ox, bag, box, ago, fox, had, queer*.
4. "Practical Writing," Book V, pages 1-2; or "Merrill's Penmanship," Book V, pages 1-2.

Assignment XX

A. BOARD WORK

1. Movement drill as required.
- NOTE.—Watch for improvement in uniformity and lightness of line as a test of free control.
2. Copy the following from the instructor's model: *eat, if, is, usual, with*.
 3. Special study, if necessary, of *e, i, u, w*.

B. TABLE WORK

1. Movement drill as required.
2. Copy instructor's model of a letter ordering a bill of foodstuffs from a mail-order house.
3. "Practical Writing," Book V, pages 3-4; or "Merrill's Penmanship," Book 5, pages 3-4.

Assignment XXI

A. BOARD WORK

1. Movement drill.
2. Write the following words: *made, need, remain, second*.

B. TABLE WORK

1. Movement drill.
2. Write a letter to a mail-order house ordering a bill of goods. Correct with instructor's model.
3. "Practical Writing," Book V, pages 5-6; or "Merrill's Penmanship," Book V, pages 5-6.

Assignment XXII

A. BOARD WORK

1. Movement drill as required.
2. Write the following words: *promise, visitor, dizzy*.
3. Special drill, if necessary, on *p, v, z*.

B. TABLE WORK

1. Movement drill as required.
2. Copy instructor's letter to a mail-order house ordering several articles of clothing.
3. "Practical Writing," Book V, pages 7-8; or "Merrill's Penmanship," Book V, pages 7-8.

Assignment XXIII

A. BOARD WORK

1. Movement drill as required.
2. Write the following words and correct from instructor's model: *Akron, Ohio*.

B. TABLE WORK

1. Movement drill.
2. Write a letter to a mail-order house ordering a pair of shoes. Correct and rewrite from instructor's model.
3. "Practical Writing," Book V, pages 9-10; or "Merrill's Penmanship," Book V, pages 9-10.

Assignment XXIV

A. BOARD WORK

1. Movement drill as required.
2. Write the following words: *Boston, Denver, Pittsburgh, Rochester*.

B. TABLE WORK

1. Movement drill. (Select that type of drill on ovals or lines over which the student lacks control.)
2. Write a letter to a publishing house ordering a year's subscription to a current periodical. Correct with instructor's model.
3. Write from model: *Akron, Ohio, Boston, Denver, Pittsburgh, Rochester*.
4. "Practical Writing," Book V, pages 11-12; or "Merrill's Penmanship," Book V, pages 11-12.

Assignment XXV

A. BOARD WORK

1. Movement drill as required.
- NOTE.—Point out student's improvement over previous work.
2. Write the following words: *Cambridge, Exeter, Farragut, Georgia*.

B. TABLE WORK

1. Movement drill as required.
2. Write a letter to a landlord asking for certain improvements and repairs in a tenement or house. Reserve this for rating and for future comparisons.
3. Write and correct from instructor's model: *Cambridge, Exeter, Farragut, Georgia*.
4. Special study, if necessary, on *A, O, B, D, P, R, C, E, F, G*.
5. "Practical Writing," Book V, pages 13-14; or "Merrill's Penmanship," Book V, pages 13-14.

Assignment XXVI

A. BOARD WORK

1. Movement drill.
2. Write from instructor's model: *Hanover, Italy, Jamaica, Klondike*.

B. TABLE WORK

1. Movement drill as required.
2. Write from instructor's model: *Hanover, Italy, Jamaica, Klondike*.
3. Special study, if necessary, on the correct formation of *C, E, F, G, H, I, J, K*.
4. "Practical Writing," Book V, pages 16-17; or "Merrill's Penmanship," Book V, pages 16-17.

Assignment XXVII

A. BOARD WORK

1. Movement drill.
2. Write from instructor's model: *Lincoln, Maine, Nebraska, Quebec*.

B. TABLE WORK

1. Movement drill as required.
2. Write *Lincoln, Maine, Nebraska, Quebec*. Correct from instructor's model.
3. Write a letter to a former employer asking for reemployment. Correct from instructor's model.
4. "Practical Writing," Book V, pages 18, 19, 20; or "Merrill's Penmanship," Book V, pages 18, 19, 20.

Assignment XXVIII

A. BOARD WORK

1. Movement drill, if necessary.
2. Write *Savannah, Trenton, Utica, Venice*. Correct from instructor's model.

B. TABLE WORK

1. Movement drill, if necessary.
2. Write *Savannah, Trenton, Utica, Venice*.
3. Special study, if necessary, on correct formation of *L, M, N, Q, S, T, U, V*.
4. Write a letter of acceptance of an offer of employment. Correct and rewrite from instructor's model.
5. "Practical Writing," Book V, pages 24, 25, 26; or "Merrill's Penmanship," Book V, pages 24, 25, 26.

Assignment XXIX

A. BOARD WORK

1. Movement drill, if necessary.
2. Write: *Washington, Christmas, New York, New Zealand*. Correct from instructor's model.

B. TABLE WORK

1. Movement drill, if necessary.
2. Write and correct: *Washington, Christmas, New York, New Zealand*.
3. Write a letter to the Federal Board of Vocational Education, Washington, D. C., asking about the opportunities for reeducation in his home district. Correct and rewrite.
4. "Practical Writing," Book V, pages 27, 28, 29, 30; or "Merrill's Penmanship," Book V, pages 15-20.

Assignment XXX

A. BOARD WORK

1. Movement drill as required.
2. Special review exercises of those capital letters which give the man the most difficulty.

B. TABLE WORK

1. Movement drill as required. (Compare the ovals written in this assignment with those written in assignments 15-10-15-20.)

2. Special review study of any capital letters which give the student special difficulties.
3. Write a letter to the Federal Board for Vocational Education describing his condition and stating his preference for an occupation after discharge. Rate this on a standard scale and compare with earlier copies. Report the amount of progress.
4. "Practical Writing," Book V, review pages 20-24; or "Merrill's Penmanship," Book V, review pages 20-24.

Rehabilitation monograph. Joint Series No. 10.

Typewriting I, II, III, IV, V—Teachers' Manual

FOR PROFESSIONALS AND AMATEURS

January, 1919—Trial edition

QUALIFICATIONS OF STUDENTS

These units (1 to 5) provide for two types of learners.

(1) *Vocational user*.—The man who is physically and educationally qualified to devote a portion of each day to serious mastery of the typewriter with vocational aim and with the idea of articulating his hospital training with an agency of later instruction.

(2) *Amateur user*.—The man who wishes to acquire sufficient skill in the operation of the typewriter to type his personal mail in the conduct of his individual business affairs, address envelopes, and make carbon copies.

NOTE.—There will be a third group of beginning typewriter users in the hospital—those who may profitably be permitted to experiment with the typewriter for therapeutic advantage, this class of patients being given the same demonstration of the machine provided in unit 1 for the professional and amateur students. This will acquaint them with the mechanics of the machine and the proper method of its operation. They may then be left to their own devices as to plan of procedure and mastery.

METHOD TO BE USED

1. The plan of instruction for the professional and amateur groups should be uniform, the only difference being in the amount of time devoted to the subject and the number of units covered.

2. In all cases learners should be trained in the use of all the fingers of each hand by the touch method.

NOTE.—In case of the amateur group, it may be well to eliminate the use of shields and blanked keyboards, at the same time insisting upon the use of all fingers and directing progress continuously along the lines of touch.

3. A combination of class and individual instruction plan should be followed, points of general interest being covered in class, after which the student's progress and instruction will be individual.

4. The instructor may base his work on any one of three standard texts, special outline courses for which are being prepared as noted in preface and later referred to under "Equipment."

TIME AND CHARACTER OF UNITS

First unit.—Mastery of keyboard and a working familiarity with the typewriter mechanism, estimated sufficient to qualify the operator to write simple business letters. Estimated time required, two 45-minute periods a day for 30 days.

NOTE.—At end of first unit envelope addressing and carbon copying should be taught to those who have no time available for later units.

Second unit.—Drills in technique: Speed practice from simple printed matter with a speed of at least 125 strokes per minute is attained with a margin of error of one stroke. No estimate as to time required; personal equation varies.

Third unit.—Practice on letter forms and copying simple literary articles. Time required two 45-minute periods for 10 days.

Fourth unit.—Practice on business and legal documents. Time required, two 45-minute periods for 10 days.

Fifth unit.—Tabulating, rough draft, and office practice. Time required, two 45-minute periods for 10 days.

EQUIPMENT

(a) *Typewriters.*—All standard makes of typewriters having universal keyboards are available, but the following alphabetical list gives the machines most generally used for instruction purposes:

L. C. Smith.
Monarch.
Remington.
Royal.
Underwood.

(b) *Textbooks.*—The following texts in typewriting are used as the basis for the five unit courses outlined in this Manual:

Charles E. Smith, "A Practical Course in Touch Typewriting," Isaac Pitman & Sons, 2 West Forty-fifth Street, New York. \$0.60.

Fritz & Eldridge, "Essentials of Expert Typewriting," American Book Co., 100 Washington Square, New York. \$0.85.

Rupert P. So Relle, "Rational Typewriting," Gregg Publishing Co., 77 Madison Avenue, New York. \$1.

(c) *Blank keys, shields, aprons.*—Such mechanical devices have a value in teaching with certain classes of students. Their principal value is to be found in the following:

Blank keys are valuable only in forcing the student to *memorize the keyboard*. They have no value beyond that, and can not be considered as a substitute for teaching typewriting.

Shields are a better device than the blank keys, but they have many disadvantages. They force the student to write by "touch" but do not offer an opportunity to observe the method of operation followed by the student.

Aprons serve the same purpose as shields. They have the advantage of giving the student freer play in handling the machine.

GENERAL SUGGESTIONS FOR MAKING THE TEACHING OF TYPEWRITING INTERESTING AND EFFECTIVE

INTRODUCTION

In selecting and discussing the points to be considered in the teaching of typewriting the interest value of each point is considered of supreme importance. With interest awakened and maintained, the other problems will be found to be easy of solution. The teacher who would secure the greatest and the most lasting results, therefore, will need to devote his attention to this feature of his work. Many of the topics have been introduced specifically for this purpose. All of them are susceptible of individual variation.

HISTORY OF THE TYPEWRITER

No student should be allowed to master the typewriter without knowing a bit of its interesting history.

The first record of an attempt to produce a typewriter is found in the British patent office in the year 1714, when a patent was granted to Henry Mills on a device intended "for the impressing or transcribing of letters singly or progressively, one after another as in writing." Mills's impractical model was followed by many futile efforts on both sides of the Atlantic, but it was more than 150 years before a practical typewriter was invented. During the winter of 1866-67 C. Latham Sholes, Samuel W. Soule, and Carlos Glidden produced in a small printing shop in Milwaukee the first practical typewriter. It was, of course, a very crude and unsatisfactory instrument and passed through various stages of failure until the year 1873. E. Remington & Sons, the great gunmakers at Ilion, N. Y., undertook the refinement and perfection of the typewriter which became known as the Remington

typewriter. It began to gain favor when placed on exhibition at the Centennial Exposition in Philadelphia in the year 1876. Thereafter its success was assured. As late as the year 1882 there were not more than 15,000 typewriters in actual use in this country, whereas to-day more than one of the great typewriter companies manufactures a machine a minute and maintains an agency in every civilized nation on earth. The Remington No. 1 was followed by later models, and many other popular makes have now established reputations and have been referred to in an earlier paragraph of this Manual.

THE TECHNIQUE OF TYPEWRITING

The machine itself a factor of interest.—The typewriting machine possesses an inherent fascination to the average student. It makes an appeal like every other instrument that “works.” At first a mystery, the student at once wants to solve its mechanical functions—wants to write upon it—and this desire should be satisfied as soon as practicable. The first lesson should contain some drill which enables the student to operate the keys, even though in a primitive way, but not to such an extent as to start the formation of habits that can not become a fixed feature of the instructions in operating the machine even in the most advanced stages of writing. Interest in the mechanics of the machine can be kept alive by progressive studies in the functioning of the various parts, and by demonstrating the usefulness of each feature.

Gymnastics.—Well-thought-out finger gymnastics can be used with great advantage because of their interest value. They undoubtedly have some value in helping certain students to make their hands and fingers more flexible. They will appeal to the student because he will be able to see at once that such exercises may have a bearing on the question of effective keyboard manipulation. The most important of these are given in “Weise & Smith’s Seven Speed Secrets,” published by Harold Smith, State College, Pullman, Wash.

Music and rhythm.—The importance of rhythm in typewriting can not be overemphasized. Rhythm simply means tapping the keys in even time. Rhythm enables the typist to finger each key properly and to deliver the same amount of energy on each stroke. The result is clean-cut impressions and greater speed. Rhythm can be taught in several ways. By tapping the desk at regular intervals as the class practices a given exercise; by dictating a list of words in even time or by the use of a Victrola or other phonograph. Much success has been acquired by the use of the Victrola. The stimulating effect of music is well recognized. The chief difficulty about this method is to secure the proper records. At the beginning of the work in typewriting the teacher should demonstrate the proper method of acquiring rhythm. As most students have a natural conception of “time” as applied to music there will be little difficulty in driving the idea home. The theme should be constantly iterated, however, until each member of the group has acquired a rhythmic touch.

Dictation direct to the machine.—This is a valuable device to use from the very beginning in typewriting and can be continued throughout the course with advantage. The particular advantages of dictation directly to the machine are: It forces the student to keep up with the pace of the teacher rather than to rely upon his own volition. It prevents him from falling into sluggish habits of typing. It cultivates his hearing—which is a very valuable training for both shorthand and typewriting. In giving dictation the teacher can require the students to look directly at him, thus keeping their eyes off the keyboard.

At the beginning of the work the best method of giving dictation is to dictate a letter of a word at a time—not pronouncing the word. This is a valuable exercise in testing the student’s ability and giving him practice in finding keys quickly. The words can be written on the board a letter at a time as they are dictated. The object of this is to let the student see the letter as well as hear it and to prevent confusion. By not pronouncing the word the student is kept alert to catch each letter, otherwise he would proceed with the entire word as soon as he anticipated what it was. Dictation on the machine has a very great attraction for most students.

Practice away from the machine.—This is a form of exercise which may be made to yield excellent results and it also stimulates an interest in the work from a different angle. It can only be used, however, after the student has visualized the keyboard fairly well. It consists in simply locating mentally the positions of keys while reading and going through the mental

process of striking them. Students generally reach a stage when this kind of practice comes involuntarily. They find themselves spelling out on an imaginary keyboard the advertising signs they see in cars, the signs on the street, etc.

Mechanics of the machine.—Students at times tire of the purely manipulative part of typewriting. The introduction of studies about the mechanism of the machine will be welcomed as a pleasing and valuable diversion. A study of the complete instruction books issued by the makers of the various machines with diagrams on the board or a personal demonstration of the functions of the various parts of the machine will prove a valuable aid in teaching.

THE MAIN PARTS OF THE TYPEWRITER A STUDENT SHOULD KNOW

- | | |
|------------------------------------------------|---------------------------------------|
| 1. Paper table. | 13. Carriage-release key. |
| 2. Platen (cylinder or rubber roller). | 14. Finger keys. |
| 3. Thumb wheels. | 15. Space bar. |
| 4. Feed rolls (three in front, three in back). | 16. Type bars. |
| 5. Paper guides or fingers. | 17. Type keys—upper case, lower case. |
| 6. Marginal scale. | 18. Shift keys. |
| 7. Marginal stops. | 19. Shift lock. |
| 8. Marginal release. | 20. Back spacer. |
| 9. Line-space gauge. | 21. Ribbon-crank handle. |
| 10. Line-space lever. | 22. Printing point. |
| 11. Paper-release key. | 23. Ribbon reels or spools. |
| 12. Carriage. | |

Exhibits of students' work.—There is nothing more encouraging to a student than to find that he has produced something which is worthy of the notice of his fellow classmates. Good specimens of students' work should be kept constantly on the bulletin board. It will stimulate others to try to excel. Specimens of correct forms of various letters and documents can also be used to advantage. For example: The teacher may prepare a series called, "The evolution of the business letter," showing the shorthand notes, the typed letter ready for the signature, the letter signed, and the envelope.

Exhibits of experts' work.—Many specimens of this can be obtained either from the typewriter companies or from business houses. It will serve as a stimulus. These specimens, however, should be selected with very great care. Much of the work that comes from business houses which is acceptable perhaps in the office from which they come would not be accepted by others.

Records.—A great deal of uniformity can be exercised by the teacher in preparing records of the work of the various students which will appeal to the group as a class. These may be in the form of progress on the formal lessons of the textbook used. The use of graphs has been found to be of value in stimulating interest in the subject and of bringing to the student's notice the features of his work that need attention. The graphs may include such information as "speed development" as outlined in a previous paragraph; graphs of errors; graphs of progress in lessons; graphs on "speed studies," etc.

Friendly competition; desire to excel; sportsmanship.—By developing the "speed drills" into class events much upon the plan of athletic events a very strong spirit of sportsmanship can be developed. This has been found to be an excellent idea in securing results in typewriting. The principle can be extended also to all kinds of work done on the machine. Speed can be made an inexhaustible capital by the teacher. The following suggestions will serve to open up the possibilities of the subject:

In early stages:

1. Speed drills in writing certain frequently recurring combinations or sequences of letters.
2. Speed drills in writing the alphabet.
3. Speed drills in writing alphabetic sentences.
4. Speed drills on any repeated practice material from the textbook.

In the advanced stage:

1. Speed drills on practice material; connected matter.
2. Speed drills on new matter; at first on matter of low-stroke intensity.

Another excellent speed test is one which determines which pupil can hold out longest without making a single error. In order not to waste any time in this contest the pupils are asked to write for 10 minutes. At the end of the time, the pupils who have made any errors proceed with the regular work of the day, while those with perfect papers continue the test until they make an error. When a pupil makes an error he stands and the teacher writes his name on the board and the length of time he wrote without making an error. The last student to stand wins the contest. Exhibit this paper with the words "——— wrote 15 minutes before making one error."

Typewriter awards.—The leading typewriter companies maintain awards or credential departments through which worth-while prizes are given to those students who attain certain proficiency in typewriting. Test material of standardized intensity is mailed to the schools requesting it. Write the typewriter companies whose machines you use and ask to be put on the mailing list and for full particulars about the award plan.

Further cooperation from typewriter companies.—Both the Underwood and the Remington typewriter companies maintain a department for training expert typists. Some of the fastest typists in the world are now in the employ of these companies and are probably available for a free demonstration before your classes upon request. Nothing would inspire your students more than a visit from these experts.

Slides and moving pictures.—If your hospital is equipped with picture paraphernalia, write the typewriter companies for interesting slides featuring the typewriter and its mastery. The Remington Typewriter Co. has filmed 3,000 feet of motion pictures on the manufacture of the typewriter and the proper method of using it. Their instructive films will be sent free upon your request.

Artistic features of typewriting.—The beauty of the correctly written, artistically balanced page, with even impression of the type, can be utilized as an interest awakening feature. This can be very greatly increased by having *all examples of typewriting from which copies are to be made or which are to be used as models conform to the best taste.* The teacher can point out the reasons, and state the artistic principles employed. Illustrations of printed matter; applicable to typewriting, can be used with great advantage. The constructive abilities of the student can be awakened through this means.

Getting accuracy.—The student should not think too much about speed in the early stages of his work. He should follow the instructions of his teacher and look upon speed as a growth to be noted only at intervals of a few weeks apart. To expect to see an increase in speed from day to day is like expecting to see a tree grow. When the student is able to write from ten to twenty words a minute on the typewriter the most potent influence to increase his speed is judicious, accurate repetition. The value of repetition decreases as the speed of the student increases.

Fingering exercises should be considered in the light of *first aid*. If they are practiced until they become subconscious they will smooth away many difficulties and make the student's task lighter. They should never be practiced carelessly.

The following fingering exercise has been much used by speed operators as a warming up exercise. The student who practices this exercise will find it of much assistance in learning to hold his hands in the correct position at the keyboard. It applies to the second row of keys only. Similar exercises should not be practiced on the first or the third row of keys, as to do so nullifies the benefits of this exercise. Here it is:

a;slckfjghfjcksl

Note that the fingers of each hand are used alternately. The exercise should be repeated over and over again, at least four times to each line. The student should be careful and not write this exercise too often at any one time, a few lines at a time being helpful, whereas too many times may do more harm than good.

One-hand operation.—In some cases it will be desirable to teach one-handed men to operate the typewriter and this should be comparatively easy. The position at the machine will be slightly modified—if the right hand is missing the student will sit slightly to the right of the center of the keyboard; if the left hand is gone, reverse the position. When the right hand is used let the index finger rest on the lever "s" as a pivot or guide key. All keys to

the left and including 3, e, d, and c are operated by the index finger; the next two rows by the second, the next two by the third, and the remaining keys by the fourth. The thumb is used for spacing.

In case of left-hand operation use "k" for the pivot key for index finger and allocate the keyboard to the fingers as follows: All keys to the right and including 9, i, j, n, should be operated by index finger; the first two rows to left by second finger; the next two to the third; and the remaining keys to fourth. Of course, in one-handed operation the touch system can not be completely followed, but each finger should do its share of the work. It is important that a one-armed student be assigned to a machine having a carriage return suited to his handicap.

Using the blackboard.—Make regular use of the blackboard in aiding the students to visualize the keyboard. We do not believe in the use of a wall chart as that gives the student too many letters to look at at the same time. It is desirable that he should have in front of him only the letters he is going to use. The instructor points to a letter at the same time naming it, and the student writes it. This keeps the student's eyes away from the machine, and by this method the teacher is able to develop a rhythm in striking the various letters.

After the keys have been learned the teacher uses the same method in writing words. The student is told, "We are now going to write the word 'lass.' Ready! l a s s, space," pointing to each letter on the board as the letter is pronounced. The same method is also used with short phrases and sentences, and even in using a text where phrases were not taught in the first lesson effort should be made to include some in the board practice. In this first lesson we call attention to the fact that the letter "l" may be used for the figure "1," and we have the student write such phrase as "11 sad lads."

Points to remember.—(a) Have each student assigned to a definite machine and keep a seating chart.

- (b) Have a blindfolded test occasionally.
- (c) Teach the sharp staccato blow for striking the keys.
- (d) The stop watch is a great little teacher.
- (e) Say "Good" when it is good.

ADAPTED TO "A PRACTICAL COURSE IN TOUCH TYPEWRITING"

By the author, CHARLES E. SMITH

OUTLINE OF COURSE

A thorough mastery of the keyboard is the most important element in the future progress of the student. The lessons in the first 21 budgets of "A Practical Course" have been so arranged that the student who follows the instructions in the text will have not only a thorough mastery of the keyboard but also considerably more speed than is necessary to meet the requirements of the first unit of the suggested course.

The first unit allows the student 90 minutes a day for 30 days. This gives him 45 hours practice in all. In order to accomplish the required results in this period of time the teacher should confine the work of the student to the first 12 budgets, covering the first 22 pages of the textbook.

Before commencing the work of budget 1, the student should read all the instructions in the textbook contained in the first six pages and should practice the first fingering exercise until he has thoroughly mastered it.

Budget 1

Budget 1, on page 6, contains 20 words in all. These 20 words cover the second row of keys. As the time of the student is limited, the teacher need not require the student to do any of the supplementary words on page 7, but should teach the student the second fingering exercise as soon as he has completed the 20 words of the first budget, shown on page 6.

Budget 2

The student should now examine carefully the diagram at the bottom of page 8 and note the relation of the letters U, I, O, P to J, K, L; and of Q, W, E, R to A, S, D, F. The guide

key for Q is A; the guide key for W is S, etc. Notice that each new letter is above and slightly to the left of its corresponding guide key. If the student will keep this simple fact in mind, it will prove a wonderful help in learning the location of the new keys.

When the student leaves a guide key to strike a key on the third row, the required finger should reach forward and upward, going slightly to the left. The movement should be almost entirely a finger movement. The forearms and wrist should be held as nearly as possible in the original position assumed when the fingers were placed on the guide keys.

The supplementary words on page 9 may be omitted, the third fingering exercise on that page being taught as soon as the student has finished the regular work of the second budget, shown on page 8.

Budget 3

THE CENTRAL KEYS

The letters T and G are struck with the first finger of the left hand and the letters Y and H with the first finger of the right hand. As these letters are in the center of the keyboard there is a tendency, when striking them, to move the other fingers out of the normal position.

To strike G the typist should "stretch" the first finger of the left hand from its position over F until it is over G, and after striking G, the finger should be instantly returned to its normal position over F. A similar method should be followed when striking H with the first finger of the right hand.

It is apparently easier for the typist to move the whole hand over when striking one of the central letters. If he does this it results in a wrist movement instead of a finger movement and gets the other fingers out of position, making the typist inaccurate. If the typist will keep in mind that he must cultivate a finger movement when striking these letters and "stretch" the fingers to the right and left respectively, he will have little, if any, difficulty in mastering them.

To strike T the first finger of the left hand should be stretched to the right and in addition should reach forward and upward. Similarly to strike Y the first finger of the right hand should be stretched to the left and should reach forward and upward. When striking these particular letters there is a slight forward movement of the whole hand. After the letters are struck, however, the fingers should all come back instantly to their respective positions over the guide keys.

SHIFT KEYS

After finishing the 20 words of the third budget on page 10, the teacher may omit the supplementary words and at once instruct the student in the use of the shift key, having him write one line each of the four words shown on page 11.

SENTENCES

The teacher should now require the student to do each of the five sentences on page 11 at least four times, using a half sheet of paper for each sentence. As some of the sentences are shorter than others, the teacher may use this fact to show the student how to set the marginal stops, so as to display the work to the best advantage.

Budget 4

Before beginning the work of budget 4 the teacher should require the student to read carefully the instructions on page 12 with reference to the fourth fingering exercise. This fingering exercise should be practiced until the student can do it readily and accurately.

The teacher may be asked why he requires the student to strike the B with the first finger of the right hand. The fingering indicated in "A Practical Course" for the first row of keys tends, first, to equalize the amount of work done by the fingers of each hand; second, to allow the student to do his work with the least amount of finger movement; and, third, to prevent the clashing of keys, thus eliminating many of the errors which the student would otherwise make.

THE REASON WHY

The vast majority of students are right handed, so that it is easier for them to learn to strike B with the first finger of the right hand.

Not counting B, the fingers of the left hand have to take care of 14 letters of the alphabet, among which are the frequently occurring letters E, S, R, T, A, D, and C, whereas the fingers of the right hand take care of only 11 letters, or 12, if we include B. As a result, even if B is given to the right hand, the fingers of the left hand have to do a great deal more work than those of the right hand. The striking of B with the first finger of the right hand, therefore, tends to equalize the amount of work done by the fingers of each hand.

Then again, if B is struck with the first finger of the right hand, it permits the typist to use the first finger of the left hand on C and V, making it much easier and swifter to write the frequently occurring combinations EC, CE, NCE.

Another reason for striking B with the first finger of the right hand is its distance from R and U. While the distance of B from F is practically the same as from J, it should be noted that it is much farther from B to R than from B to U, so that those who strike B with the first finger of the left hand have a very awkward combination when striking the frequently occurring double consonant BR. If, however, B is struck with the first finger of the right hand, the double consonant BR is much easier to write and may be written more speedily, since the first fingers of the right and of the left hand will be used alternately.

When B is struck with the first finger of the right hand it naturally follows that C and V are struck with the first finger of the left hand, and hence X with the second finger of the left hand and Z with the third finger of the left hand. As a result the little, or fourth, finger of the left hand is not used for any of the letters on the first row of keys and so is not overworked when used to hold down the left shift key and to strike the frequently occurring vowel A.

Sufficient reasons have, perhaps, been given to make it plain why it is most important to strike B with the first finger of the right hand. There is, however, another reason which arises from the construction of the typewriter itself. Press the keys B and Y gently and note that these two keys lie side by side in the basket of the machine. Because of this fact there is danger of these keys clashing when B is struck with the first finger of the left hand and Y with the first finger of the right hand. If, however, both keys are struck with the first finger of the right hand this danger is entirely obviated. Likewise the letters E and X, as well as I and M lie side by side in the basket of the machine and hence the danger of these letters clashing with each other is entirely overcome by striking them with the second fingers of the left hand and of the right hand, respectively.

COMPLETING THE ALPHABET

The 20 words of the fourth budget, shown at the bottom of page 13, complete the alphabet. As soon as the student has finished these 20 words the teacher may allow him to omit the supplementary words on the same page and proceed at once with the sentences at the top of page 13. Each sentence should be written accurately on a half sheet of paper at least four times.

Budget 5

After practicing the fifth fingering exercise in accordance with the instructions on page 14 the teacher should have the student complete the 20 words of the fifth budget on page 15. As with the preceding budgets, the supplementary words on page 16 may be omitted.

ALPHABETIC SENTENCES

The alphabetic sentences on pages 16 and 17 should next be practiced. Each sentence should be written correctly at least four times. The student will complete these sentences more quickly if the teacher permits him to use a separate half sheet for each sentence. When this plan is followed the student should use double spacing.

Budgets 6, 7, 8, 9, and 10

Budgets 6 to 10, inclusive, should now be practiced by the student. For the purpose of the first unit the teacher should at present require the student to practice the work of each of these budgets about five times.

Budget 11

The instructions and practice work for budget 11 will be found on pages 20, 21, and 22.

The Arabic numerals have been the *bête noir* of many a student who otherwise would have been enrolled in the ever increasing army of touch typists. We have often heard typists remark that they wrote by the touch method except that they looked at the keys whenever they wished to strike one of the figures. Of course, such operators are not touch typists at all, as the term *touch typist* can only be applied to the typist who is able to strike every key with facility and without looking or desiring to look at the keyboard. The fourth row of keys can be mastered as thoroughly as any other part of the keyboard, and no typist should stop in his efforts to become a real touch typist until he has conquered the figures and special characters as well as the letters of the alphabet.

Note that the small l (el) is used for the figure 1. On some machines the capital O is used for the cipher, while others have an extra character for the cipher on the fourth row of keys. When the capital O is used for the cipher it should, of course, be struck with the third finger of the right hand. When there is an extra character for the cipher on the fourth row of keys, it should be struck with the little, or fourth, finger of the right hand. The typist should now carefully study the diagram of the keyboard and note that the figure 2 is struck with the fourth finger of the left hand, 3 with the third, 4 with the second, and 5 with the first. The first finger of the right hand should be used to strike both 6 and 7, the second finger for 8, and the third finger for 9.

The typist should always endeavor to eliminate waste motion. It is for that reason that the fingers should be kept close to the keyboard and the finger movement employed as far as possible when writing. The figures, however, are so far from the guide keys that it is necessary to move the hand slightly forward when striking a character in the fourth row. The forward movement of the hand should be just sufficient to enable the typist to strike the desired key and the hand should then be instantly returned to its position over the guide keys.

The typist should now place his fingers in the proper position on the guide keys and then write 12345, after which the fingers should be instantly returned to the normal position over the guide keys. Then write 09876 and bring the fingers of the right hand back to the proper position over the guide keys. The typist should, at first, keep his eyes on the diagram when writing these exercises. He should, however, discard the diagram as soon as possible and continue his practice with his eyes on the exercises themselves, or he may simply look straight ahead, writing the exercises from memory.

Budget 12

As soon as the student has finished the work of budget 11 he should practice the work of budget 12 five times.

SIMPLE LETTERS, CARBON COPIES, ENVELOPES

Instructions relating to letters will be found on page 30 of "A Practical Course." Directions for addressing envelopes and using carbon sheets will be found on pages 50 and 51, respectively.

For the purposes of the first unit the teacher may now ask the student to write budgets 6 and 7 five times each, using one or two carbon sheets for the purpose and making duplicates. To make the letters complete the teacher may require the student to use the following addresses with these budgets:

Budget 6:

Mr. James Kay,
Plainfield, N. J.

Budget 7:

Mr. Arthur Lewis,
99 State Street,
Chicago, Ill.

For the date line the student should use the name of the place in which he resides and date the letter on the day on which it is written.

UNIT 2.—After finishing the work of unit 1 the teacher should have the student continue the regular work of the textbook until he has done the remainder of the budgets to the end of budget 21.

The repetition of the work of these budgets should furnish more than sufficient drill to attain the rate of speed required. Budget 17 is not a speed drill in the same sense as the other budgets, but the work of this budget will give the student greater facility in the use of the figures.

If additional material is required the printed typewriting tests on pages 68 to 74, inclusive, may be used for repetition practice.

UNIT 3.—Ample practice material for the third unit will be found on pages 30 to 45, inclusive. There is, perhaps, too much material for the time allowed, so that the teacher may omit some of the letters involving tabulated exercises and these may be practiced later on when the student takes up the regular practice material provided for practice in making tabulations. (See Unit 5.)

The teacher may instruct the student to address an envelope for each practice letter.

UNIT 4.—Instructions and exercises for centering headings will be found on pages 55 and 56. After practicing the exercises for centering headings the student may proceed with the work of the fourth unit, which will be found on pages 56 to 62, inclusive.

UNIT 5.—Exercises on rough draft will be found on pages 48 and 49.

Material for tabulating will be found on pages 63 to 67, inclusive.

If the teacher allowed the student to omit the letters involving tabulations in connection with the work of unit 3 these may now be done by the student. Such letters will be found on pages 40, 43, 44, 45, and 46.

ADAPTED TO "ESSENTIALS OF EXPERT TYPEWRITING"

By the associate author, EDWARD E. ELDRIDGE

OUTLINE OF COURSE

The new text entitled "Essentials of Expert Typewriting," written by Miss Rose L. Fritz and Edward H. Eldridge, assisted by Miss Gertrude W. Craig, has been prepared especially for short courses. The keyboard development in this book is based in general upon the method which has proved so successful in the authors' earlier and larger book known as "Expert Typewriting," although in the new book phrases and sentences are introduced in the first lessons.

The book will fit admirably with very slight changes into the plan adopted by the Committee for Instruction of Soldiers.

In the text there are 26 lessons, and in each lesson 15 pieces of work to be accomplished. In the first 16 lessons the work to be done consists of 15 half-size sheets. From the seventeenth lesson on full-sized sheets are used.

UNIT 1.—Unit 1 as described by the committee calls for a mastery of the keyboard, a working familiarity with the various parts of the machine sufficient to qualify the operator to write simple letters, make carbon copies, and direct envelopes.

The authors of "Expert Typewriting" recommend for this unit the following lessons in the "Essentials of Expert Typewriting":

Lesson 1.—Keyboard drill (asdf ;lkj), words, phrases. In this lesson the use of all the fingers, placed in their proper position on the guide keys, is taught. In the judgment of the authors it is very desirable that this position row should be taught at the very beginning, for in all of the future work of the typist his fingers must hover over these eight keys.

Lesson 2.—Keyboard drill (er iu), words, phrases. In this lesson the fingers continue to keep their positions on the guide keys and to operate these keys, but the first and second fingers learn also how to operate four letters (one for each finger) on the third row of keys.

Lesson 3.—Keyboard drill (cv ,m), words, phrases. In this lesson the first and second fingers are taught how to write properly letters on the first row of keys.

Lesson 4.—Keyboard drill (g h), words, phrases. Only two new characters are taught in this lesson and both of these are written with the first finger.

Lesson 5.—Keyboard drill (tb yn), words, phrases. The first fingers are taught how to reach by the sense of touch the remaining letters which they must operate. It will be noticed

that throughout these five lessons the third and fourth fingers, which because of their relative weakness need special training, have been used in each lesson, but they have been used all the time each on a single key and have not had the additional burden of hunting around the keyboard for other keys.

Lesson 6.—Keyboard drill (wx o.), words, capitals, sentences. The third fingers having now been somewhat strengthened by their preliminary practice on the guide keys, are taught how to move up and down the keyboard to reach the other keys which they must operate.

Lesson 7.—Keyboard drill (qz ;/), words, capitals, sentences. In this lesson the fourth fingers are taught how properly to operate the keys which belong to their section of the keyboard.

These seven lessons (which should be properly written in about 35 class periods of 45 minutes) teach the location and operation of all the letters on the three lower banks of keys.

Lesson 8.—This consists of a keyboard review with words especially selected to exercise the fingers of the right hand and of the left hand separately. The lesson also contains drills on capitals and sentences.

Lesson 9.—In this lesson each of 75 words which have been selected because they contain common letter combinations, is written several times. The object of the lesson is to fix in the student's mind the proper fingering of the keyboard and to give drills in the writing of many useful letter combinations.

Lessons 12 and 13.—These lessons include drills on the figures and other characters of the upper row of keys. In the text these are preceded by two lessons which are designed to give additional facility in the use of the three lower rows; but in order to complete unit 1 in the time required, it is desirable to omit lessons 10 and 11 in this unit and include them in the second.

Lesson 14.—In this the student is taught how to write a number of short letters, each of which contains all the letters of the alphabet and some of the characters on the upper row. The lesson also includes a number of alphabetic sentences. Before the student writes this lesson he should be taught how to use the tabulator in making paragraphs. This is described in the instructions to lesson 11, to which reference should be made.

The work of the first unit is now completed and consists of 12 lessons, which the average student should complete in about 60 periods.

If the student does not expect to continue his work beyond this unit, it would be desirable to omit lesson 9 and use the extra five periods to give information regarding the arrangement of addresses on letters, addresses on envelopes, writing with carbon paper, etc. Information as to how to teach these will be found in later lessons in the book. If, however, the student is to continue his course, it would be much wiser to postpone these subjects until he has gained more facility in his work.

UNIT 2.—The committee describes this as speed drill. Practice from simple printed matter until a speed of at least 125 strokes a minute is attained with a margin of error of one stroke. No estimate of time is given for this, as the personal equation varies.

For this unit the authors of "Essentials of Expert Typewriting" recommend the following lessons:

Lesson 10 (to be preceded by lesson 9, unless this was included in unit 1).—This lesson is an exceedingly important drill on sentence practice. It is made up of 30 sentences, which are composed exclusively of the most commonly used words in the English language. These sentences contain less than 150 separate words and yet these words, because of their frequent repetition, will comprise practically one-half of all the matter which the typist is likely to be called upon to write. The importance of gaining skill in the writing of such words, especially when they are combined in sentences, will be readily recognized.

Lesson 11.—Fifteen short articles to be copied by the student, in order to give practice in copying from typewritten copy.

Lessons 15 and 16.—Two lessons, which include alphabetic sentences and short letters, each of which contains all the letters of the alphabet. These will give additional facility in writing from typewritten matter.

These four lessons should be supplemented by copying from printed matter. In the judgment of the authors it is wise at this stage to have the student write for single minutes

from new copy. The speed tests published by the Remington and the Underwood typewriter companies give excellent material for this practice. These tests may be obtained from the companies without charge.

The work from the textbook outlined for this unit will take approximately 20 periods. In most cases it will be found that by this time the student has the necessary speed, while in other cases it may be necessary to continue the practice of copying from printed matter for a somewhat longer time. If it is necessary so to continue, it is recommended that the student use the alphabetic sentences in lessons 15 and 16 at the beginning of the period for review of the keyboard and that the sentences in lesson 10 be written and rewritten, in order to increase the finger dexterity. Care should be taken that the student does not at this stage write so rapidly as to become inaccurate.

UNIT 3.—Practice on various letter forms, addressing envelopes, and copying simple literary articles. Time allowed, 20 periods.

Lessons 17, 18, 19, 20, 21, and 22 in the "Essentials of Expert Typewriting" contain letters on full-sized sheets to be copied from typewritten copy, other letters to be arranged and written from printed copies, envelopes to be addressed; carbon copies to be written, etc. Two of the lessons contain facsimile illustrations of letters showing the style recommended by prominent business concerns. Included in the lessons are drills in centering, words commonly misspelled, Roman numerals, business terms, and business abbreviations. Articles printed in ordinary type to be typewritten by the student include folding of letters, use of carbon paper, filing letters, card systems, typewriter ribbons, and semisocial letters.

These lessons if written as instructed in the text will take 30 periods. As the time allowed for this unit is 20 periods, it is recommended that in doing the work only one copy be made of exercises 2, 3, and 4 in each of the lessons, and that if necessary exercise 7 be omitted.

UNIT 4.—Practice on business and legal documents. Time allowed, 20 periods.

Lesson 23 includes writing on postal cards, on index cards, on library cards, writing on ruled lines, preparing telegrams, writing letters confirming telegrams, preparing stencils and running them off, etc.

Lesson 26 contains 15 legal and corporation forms and includes the backing and indorsing of the legal documents.

These lessons can be completed in from 15 to 20 periods.

UNIT 5.—Tabulating and rough draft. Time allowed 20 periods.

Lesson 24.—Bills, tabulations, balance sheet, problems. This lesson gives a number of examples of tabulation and of bill forms, together with problems in plain type which are to be properly tabulated.

Lesson 25.—In this lesson are included examples of rough draft, a title-page, a page showing arrangement of table of contents, practice in making borders, etc.

In these two lessons are given all the essentials necessary for this unit. Time required from 15 to 20 periods.

In the five units, as given above, have been included all the lessons which are given in the "Essentials of Expert Typewriting," and in the judgment of the authors this includes all that is necessary in order to teach the *essentials*.

The committee recommends that in all the units from 3 to 5, inclusive, there should be speed practice given. This speed practice may be varied as the teacher desires. The tests supplied by the typewriter companies give good practice material. Repetition work on sentences is also valuable. The authors recommend that the sentences in lesson 10 be used frequently throughout the course. In the text it is suggested that perfect copies be required. In the judgment of the authors it would be unwise to require this with the class of students the committee is providing for, but it is desirable to insist upon a high standard of accuracy and not to accept papers which contain too large a number of errors.

If any teacher using the "Essentials of Expert Typewriting" for this work desires additional information on any point the authors will be glad to give what assistance they can.

ADAPTED TO "RATIONAL TYPEWRITING" (MEDAL OF HONOR EDITION)

By the author, RUPERT P. SO RELLE

OUTLINE OF COURSE

First unit

Sixty periods of 45 minutes each. (Mastery of the keyboard, and a working familiarity with the various parts of the machine; simple letters; carbon copies; directing envelopes.)

Period 1:

- (a) Explanation of machine and necessary working parts mentioned on page 5.
- (b) Explanation of keyboard using charts on page 4, and the machine itself for further illustration.
- (c) "Position at machine," pages 5, 6.
- (d) "Touch and fingering," page 6.
- (e) "How to begin," pages 6, 7.
- (f) Explanation of finger divisions in a general way with special reference to central division.
- (g) Preliminary practice in acquiring touch (striking keys).

Period 2:

- (a) Review previous period's work.
- (b) Drill on memorizing central division.
- (c) Writing, first exercise, page 8.

Period 3:

- (a) Review on location of keys.
- (b) Drills on striking different keys.
- (c) Second exercise, page 8.

Period 4:

- (a) Drills in locating keys.
- (b) Rhythm drills.
- (c) Words of high frequency, page 7.
- (d) Third exercise, page 8.

Period 5:

- (a) Explanation of second finger division.
- (b) Memorizing new keys.
- (c) Preliminary drills in locating keys.
- (d) First exercise, page 10.

Period 6:

- (a) Location and rhythm drills.
- (b) Second exercise, page 10.

Period 7:

- (a) Features of machine, page 9.
- (b) Third exercise, page 10.

Period 8:

- (a) High frequency words, page 9.
- (b) Supplementary exercise, page 9.

Period 9:

- (a) Explanation of third finger division.
- (b) Preliminary drill on third finger keys.
- (c) First exercise, page 12.

Period 10:

- (a) Location and rhythm drills.
- (b) Second exercise, page 12.
- (c) Words of high frequency, page 11.

Period 11:

- (a) Features of machine, page 11.
- (b) Third exercise, page 12.
- (c) Special third finger exercise, page 11, writing one line of each word only.

Period 12:

- (a) Instruction and preliminary exercise, page 13.
- (b) First exercise, page 14.

Period 13:

- (a) Location and rhythm drills.
- (b) Second exercise, page 14.
- (c) High frequency words, page 13.

Period 14:

- (a) Features of machine, page 13.
- (b) Third exercise, page 14.
- (c) Supplementary exercise, page 13, one line of each word only.

Period 15:

- (a) Instructions and suggestions, page 15.
- (b) Capital letters, page 15.
- (c) First exercise, page 16.

Period 16:

- (a) Rhythm drills.
- (b) Words of high frequency, page 15.
- (c) Second exercise, page 16.

Period 17:

- (a) Features of machine, page 15.
- (b) Third exercise, page 16.
- (c) Supplementary exercise, page 15, one line of each word only.

Period 18:

- (a) Instructions and suggestions, page 17.
- (b) First exercise, page 18.
- (c) Words of high frequency.

Period 19:

- (a) Supplementary exercise, page 17.
- (b) Second exercise, page 18.

Period 20:

- (a) Parts of machine, page 17.
- (b) Third exercise, page 18.

Period 21:

- (a) Study "Instructions and suggestions," page 19.
- (b) First exercise, page 20.

Period 22: Second exercise.

Period 23:

- (a) Location and rhythm drills.
- (b) Third exercise, first two sentences.

(NOTE.—Beginning with the third exercise, an effort should be made to increase speed. Each of the sentences should be written at least 10 times. The exercise can be completed in the 45-minute period if the student can average 10 words a minute. The first group of figures in the parentheses indicates the number of words in the sentence; the figures following the hyphen, the average number of strokes in a word. The sentences may be used for speed drills. It would be well for the student to practice each of the long words in each sentence a few times before writing the complete sentence.)

- (c) Assign for study "Numerals," page 19. The class group should be questioned on this at the next recitation.

Period 24:

- (a) Quiz on numerals, page 19.
- (b) Words of high frequency, page 19.
- (c) Third exercise, third sentence, page 20.

Period 25:

- (a) Study "Eighth lesson," page 21.
- (b) First exercise, page 22.

Period 26:

- (a) Words of high frequency, page 21.
- (b) Dictation drills on words of high frequency, page 21.

Period 27:

- (a) Second exercise, page 22. Repeat as many times as the time permits.
- (b) Study numerals, page 21.

Period 28:

- (a) Quiz on numerals, page 21.
- (b) Speed drills on third exercise, page 22.

Period 29:

- (a) "Instructions and suggestions," page 23.
- (b) Words of high frequency, page 23.

Period 30:

- (a) Dictation drills on words of high frequency, page 23.
- (b) First exercise, page 24.

Period 31:

- (a) Second exercise, page 24.
- (b) Study of "Spacing after punctuation marks," page 23.

Period 32:

- (a) Quiz on "Spacing after punctuation marks," page 23.
- (b) Speed drills on third exercise, page 24.

Period 33:

- (a) "Instructions and suggestions," page 25.
- (b) Words of high frequency, page 25.

Period 34:

- (a) Dictation drills on words of high frequency.
- (b) First exercise, page 26.

Period 35: Second exercise, page 26.

Period 36: Third exercise, page 26.

Period 37:

- (a) Study "Things you ought to know," page 25.
- (b) Speed drills on fourth exercise, page 26.

Period 38:

- (a) "Instruction and suggestions," page 27.
- (b) Words of high frequency, page 27.

Period 39: First exercise, page 28.

Period 40:

- (a) Dictation drills on words of high frequency, page 27.
- (b) Second exercise, page 28.

Period 41: Third exercise, page 28.

Period 42:

- (a) Study "Things you ought to know," page 27.
- (b) Speed drills on fourth exercise, page 28.

Period 43:

- (a) "Instructions," page 29.
- (b) First section, words of high frequency, page 29.

Period 44: First exercise, page 30.

Period 45: Second exercise, page 30.

Period 46: Third exercise, page 30.

Period 47:

- (a) Second section, words of high frequency, page 29.
- (b) Fourth exercise, page 30.

Period 48: One correct copy of "Spacing after punctuation marks," page 23.

Period 49: One copy of "Things you ought to know," page 25.

Period 50:

- (a) Copy the following from "Things you ought to know," page 27, paragraphs 1, 2, 7, 8, 10.
- (b) Make copy of "Things you ought to know," page 29.

Period 51:

- (a) Study "Introduction to business correspondence," page 41.
- (b) Study and make one correct copy of letter on page 45.

Period 52:

- (a) Study "Folding letters," page 42.
- (b) Using style study I, page 45, as a model, copy letters given in first and second exercise, page 46. Repeat, if necessary, until well-arranged, correct copies are produced.

Period 53:

- (a) Study self-starter and tabulator keys, and uses, pages 42, 43.
- (b) Using style study I as a guide, rearrange exercises 3, 4, 5, page 46.

Period 54:

- (a) Study "Manifolding," page 43.
- (b) Study style study II, page 44, and make one copy. Make one carbon copy of each.

Period 55: Using style study II as a guide rearrange exercises 1 and 2, page 48. Make one carbon of each.

Period 56: Prepare exercises 3 and 4 in accordance with instructions for period 55.

Period 57:

- (a) The teacher will instruct the class group as to the proper form for a personal letter.
- (b) Write a personal letter of your own composition to a friend.

Period 59:

- (a) Study "Directing envelopes," pages 70-71.
- (b) Direct envelopes according to addresses given, page 72.

Period 60:

- (a) Study illustrations of finished letter, page 63.
- (b) Write a personal letter, making one carbon copy.

Second unit

(Speed drills. Practice from simple matter until a speed of at least 125 strokes a minute is attained, with a margin of error of one stroke.) Time: Indefinite as personal equation varies. (Note: Probably a majority of the students who intelligently have gone over the part of the textbook outlined in the foregoing will have acquired a speed approximating the standard established. The following speed drills will be valuable, chiefly in greatly increasing that speed.)

OUTLINE OF PROGRAM

1. The student should make a study of the points covered in "Introduction to speed studies," beginning page 31. This will prepare the student for the problem before him. The work for speed drills is presented fully in lessons 13-17, inclusive, of "Rational Typewriting," medal of honor edition.

METHOD OF HANDLING THE SPEED STUDIES

Beginning with the first exercise on page 34, the work should be assigned for copying practice, and the exercise repeated until the indicated speed is reached.

On this section the teacher will have an opportunity to put into operation the competitive speed drills mentioned in the Teachers' Manual.

Thirty to 40 periods profitably can be put on this section of "Rational Typewriting." The value of emphasis on this part of the technique of typewriting is not altogether appreciated by teachers. The object of introducing the "speed studies" at this time is to develop a smooth, flowing style of operation of the keyboard—to transfer this operation, in fact, to the reflex—before the student's attention is diverted to the matter of arrangement of business letters and various documents. The tendency, when the student reaches letters and matter requiring judgment in arrangement, is to slow down. If he has already acquired automatism or approximate automatism—in operating the keyboard, the problem of arrangement is greatly simplified.

Third unit

Practice on various letter forms, addressing envelopes, and copying simple literary articles. Time required, two 45-minute periods for 10 days (20 periods).

OUTLINE

Period 1:

- (a) Review the "Introduction to business correspondence," page 41.
- (b) Copy style study II, page 47.
- (c) First and second exercises, page 48.

Period 2: Third and fourth exercises, page 48.

Period 3:

- (a) Style study III, page 49.
- (b) First exercise, page 50.

Period 4: First and second exercises, page 50.

Period 5: Style study IV, page 51.

Period 6: First and second exercises, page 52.

Period 7: Style study V, page 53.

Period 8: First, second, third, and fourth exercises, page 54.

Period 9:

- (a) Style study VI, page 55.
- (b) First exercise, page 56.

Period 10: Second and third exercises, page 56.

Period 11:

- (a) Style study VII, page 57.
- (b) Second exercise, page 58.

Period 12: First and third exercises, page 58.

Period 13: Style study VIII, pages 59-60.

Period 14: First exercise, page 61.

Period 15: Second exercise, page 61.

Period 16: Third exercise, page 62.

Period 17: Telegraphic messages, pages 64-65.

Period 18:

- (a) Review "Carbons," "Folding letters," "Postal cards."
- (b) Original letters.

Period 19:

- (a) Review "Tabulator," and "Self-starter."
- (b) Review "Directing envelopes," pages 70-71.
- (c) Address envelopes, page 72.

Period 20:

- (a) Study "Characters not on the keyboard," page 72.
- (b) Write the following letters, making one carbon of each, prepare envelope, get them signed by the teacher, properly fold, ready for mailing. Pages 47, 49, 51.

Fourth unit

Practice on business and legal documents. Time, two 45-minute periods for 10 days (20 periods).

OUTLINE

(Note.—In order to avoid the slowing up of speed on this kind of matter it is recommended that alternate periods be devoted to speed work. Magazine articles or any suitable material may be used. "Shorthand Dictation Drills" contains specially selected material for this purpose. It is printed in large type to make copying easy.)

Period 1:

- (a) Study pages 85, 86.
- (b) Copy page 87.

Period 2: Speed drills.

Period 3: Page 88.

Period 4: Speed drills.
 Period 5: Page 89.
 Period 6: Speed drills.
 Period 7: Page 90.
 Period 8: Speed drills.
 Period 9: Page 91.
 Period 10: Speed drills.
 Period 11: Page 92.
 Period 12: Speed drills.
 Period 13: Page 93.
 Period 14: Speed drills.
 Period 15: Page 94.
 Period 16: Speed drills.
 Period 17: Pages 95-96.
 Period 18: Speed drills.
 Period 19: Speed drills.
 Period 20: Speed drills.

Fifth unit

Tabulating and rough draft. Time, two 45-minute periods for 10 days (20 periods).

OUTLINE

Period 1: Page 66.
 Period 2: Page 67.
 Period 3: Page 68.
 Period 4: Page 69.
 Period 5:
 (a) Study and discuss pages 73, 74, 75.
 (b) Copy illustration No. 3, page 74.
 Period 6: First exercise, pages 81-82.
 Period 7:
 (a) Second exercise, page 82.
 (b) First exercise, page 83.
 Period 8: Second, third and fourth exercises, page 83.
 Period 9: Fifth and sixth exercises, page 84.
 Period 10: Seventh and eighth exercises, page 84.
 Period 11:
 (a) Study "Tabulation studies," "Bills and statements," methods of billing,
 page 76.
 (b) Copy page 77.
 Period 12: Exercises 2, 3, page 78.
 Period 13: Exercises 4, 5, page 78.
 Period 14: Exercises, 6, 7, page 78.
 Period 15: Exercises 8, 9, 10, page 78.
 Period 16: Exercises, 11, 1, 13, page 78.
 Period 17:
 (a) Page 79.
 (b) Exercise 9, page 80.
 Period 18: Exercises 6, 7, 8, page 80.
 Period 19: Exercises 3, 4, 5, page 80.
 Period 20: Exercise 2, page 80.

NOTE.—Ten minutes of each of the periods to be devoted to "Speed drills."

Rehabilitation monograph. Joint Series No. 11.

Unit Course—Typewriting VI

SIGHT TYPEWRITING

January, 1919—Trial edition

A. QUALIFICATIONS OF STUDENT

This course is intended for those who wish to learn how to use a typewriter as an aid or side line to their regular occupations. It is desirable to have a common-school education before taking up typewriting. A student should at least have some foundation in English, especially in composition work, including sentence structure and punctuation. A student who lacks this foundation should be enrolled in some English course to make up the deficiency. The typewritten transcript will depend greatly upon the student's mastery of English.

B. ADVANTAGES TO BE DERIVED BY THE STUDENT

This course in typewriting will provide the systematic training that will enable the student in a comparatively short time to use the typewriter intelligently and efficiently for occasional correspondence and other written work.

C. LENGTH OF COURSE

The course is divided for convenience into 10 lessons, of two hours each, but this arrangement may be varied to suit individual conditions. An average student should complete the course in 20 hours.

D. EQUIPMENT AND MATERIALS

Machines: Standard makes, as the Underwood or Remington.

Typewriting table.

Typewriting chair.

Typewriting paper, regulation size, 8½ by 11 inches.

Carbon paper.

Erasers.

Charts showing keyboard.

Charts showing parts of the machine.

Textbooks in typewriting. (See title in Lesson I.)

E. STANDARDS FOR MEASURING AND RECORDING STUDENT'S WORK

At the end of the course, the student should be able to copy ordinary typewritten solid matter at a rate of 80 strokes per minute involving the use of all the keys and employing all the fingers. Accuracy should be emphasized because the student will acquire speed as a result of practice. Not more than one error in 100 strokes should be accepted. It is estimated from examinations recently given in typewriting speed tests that 80 strokes are the equivalent of 13 common test words with ordinary punctuation and spacing.

The student should be acquainted with the following parts of the machine and know how to use them intelligently: Paper guide, knobs, paper release, platen, space bar, carriage lever, line space gauge, marginal stops, back spacer, tabular stops, variable line spacer.

The student should know how to arrange an ordinary friendly letter and a usual business letter in accepted typewritten form.

LESSON I

(a) Position at machine.

(b) Method of inserting paper.

(c) Position of fingers on guide keys.

Key charts will be found helpful used as suggested in manuals. As these men are not planning to become professional typists, they may have peculiarities of finger control which it would not be advisable to try to overcome. In such cases special charts may be devised to suit the disability or peculiarity. When devised the chart should be faithfully followed.

(d) Write words "Page 6" three times. (Read pp. 4, 5, 6 in "Practical Course in Touch Typewriting," by Charles E. Smith, Isaac Pitman & Sons, publishers, 2 West Forty-fifth Street, New York City.)

This course is based upon Smith's textbook but instructors can easily adapt the course to fit other manuals with which they may be more familiar. The following are recommended as standard guides:

Rational Typewriting So Relle & Cutler, Gregg Publishing Co., 77 Madison Avenue, New York city.

Fritz-Eldridge Expert Typewriting, American Book Co., New York City.

NOTE.—Have each student assigned to a definite machine. Keep a seating chart.

Finger gymnastics may be used to overcome lack of dexterity.

Say good when it is good—it works like an electric shock.

Typewriting is essentially a habit-forming subject, and in teaching it all the laws of habit formation must be brought into play with the strongest possible force. This is especially true in the early stages when the pupil acquires habits that will stay with him. These are habits of position, habits that he acquires in the method of striking the keys, moving the carriage, inserting and removing paper.

When striking the key, a quick sharp blow should be used. Strike it as if it were red-hot. Confine the movement to the fingers as much as possible.

LESSON II

(a) Third row of keys; its relation to guide keys or second row.

(b) Write words on Page 8, 10 (Smith's book).

NOTE.—Introduce mechanical features of the machine as they are needed.

Both the individual and group methods should be employed. The main purpose is to permit each student to advance just as rapidly as his own ability, application, and industry will permit, and at the same time insure to him the many benefits that result from group instruction. A judicious intermingling of the two methods will bring the best results.

LESSON III

(a) Shift key.

(b) Names, page 11.

(c) Sentences, page 11.

NOTE.—Each lesson should have some definite aim and there must be no point in the student's progress where he will feel that he is simply "marking time."

Use charts with blank spaces, only inserting the keys as they are learned.

LESSON IV

(a) First row of keys, its relation to second and third rows.

(b) Words, page 13.

(c) Sentences, page 14.

NOTE.—Exhibition of good work will stimulate the pupils to greater effort and give them an incentive for better work.

You can not teach typewriting by sitting at your desk. You must give individual as well as class instruction.

LESSON V

(a) Practice exercise of all the letters of the alphabet both forward and backward. Page 14.

(b) Introduce tabulation. Copy letter, page 17.

(c) Write short letter home.

NOTE.—Introduce tabulation by asking the student how he would start a paragraph.

Students may be asked to make a diagram of the keyboard, putting in all the letters they know and indicating the fingering from memory.

LESSON VI

- (a) Copy letters, page 18.
- (b) Write short letters to friends under supervision of teacher.
- (c) Practice alphabet forward and backward.
- (d) Addressing envelopes, page 50.

NOTE.—The following speed tests may be used: One word repeated in a minute. One phrase repeated in a minute. One sentence repeated in a minute.

LESSON VII

- (a) Practice on numeral keys of fourth row.
- (b) Write sentences, pages 21, 22.
- (c) Write short letters to friends.

NOTE.—Speed tests stimulate hard and concentrated work. Success in a speed contest gratifies one's reasonable pride and is an encouragement to future effort. But do not get speed by sacrificing accuracy. Timing if begun too early has a tendency to create a desire on the part of beginners to place too much emphasis upon speed and to neglect accuracy.

LESSON VIII

- (a) Forms of business letters. Copy letters, pages 28, 31, 33.
- (b) Student writes letters to friends, supervised by instructor.
- (c) Care of machine.

NOTE.—Typing from dictation enables the typist to concentrate his attention on the manipulation of the machine. Speed is sometimes acquired more quickly in this manner than by mere copying.

LESSON IX

- (a) Tabulation; copy letter, page 43.
- (b) Student writes his own correspondence on machine, supervised by teacher.
- (a) Rule for centering a heading.

NOTE.—The characteristics of a page of good typewriting are:

- Uniform impressions and spacing.
- Well centered headlines and ample margins.
- No letters struck over wrong letters.
- No misspelled words.
- No wrongly divided words at line ends.
- Absence of dirty erasures.

LESSON X

- (a) Manifolded by means of carbon copies.
- (b) Student typewrites his correspondence, supervised by instructor.
- (c) Test material and directions.

Give the test as directed in student's lesson sheet No. 10. Student should not be allowed opportunity to practice on this copy. Repeated tests can be made by using copy of equal difficulty from Smith's Practical Course in Touch Typewriting, Rational Typewriting Textbook, and Fritz-Eldridge's Typewriting Textbook. Give test carefully and make reports as directed. It will be valuable to know what can be done in this short course.

Creditable attainment would be 800 strokes of solid matter in 10 minutes from copy, with not more than eight errors.

Use this record for reports to the educational office, to the Surgeon General, or to the Federal Board. Preserve the test papers and send them from time to time as requested in the preface.

The student's instruction sheets are planned to be given to the student day by day as each is finished. The aim is to train the student in self help and make him as independent of the teacher as possible. For convenience in printing, all instruction sheets are bound in the same pamphlet with the instructor's manual. Enough complete pamphlets will be furnished to allow the instructor to cut out each student's instruction sheet and use it separately. If duplicating devices are handy, the instructor can readily duplicate these sheets with such modifications as he desires. In special cases it may be wise to give the student the whole pamphlet, but in general the separated sheets will best conserve interest and promote progress.

PART II. STUDENT'S INSTRUCTION SHEETS

LESSON I

Read pages 4, 5, 6, "Practical Course in Touch Typewriting," by Charles E. Smith. Isaac Pitman & Sons, publishers, 2 West Forty-fifth Street, New York City. This book teaches typewriting by the touch system, but for this short course you may look at the keys. Each lesson requires two hours of study and practice.

Write words on pages 6, 7 (above book) three times each, as:

ask ask ask		
all all all	fall fall fall	loss loss loss
lad lad lad	asks asks asks	flask flask flask, etc.
alas alas alas		

LESSON II

Read pages, 7, 8, 9, 10.

Write words at bottom of page 8, arranged as in Lesson I.

Write words at bottom of page 10, arranged as in Lesson I.

LESSON III

Shift key.

Read page 11.

Write names on page 11 five times.

Write sentences on page 11 ten times.

LESSON IV

Read page 12.

Write words on page 13 three times.

Write sentences on page 14 five times.

LESSON V

Read page 14.

Practice writing alphabet forward and backward.

Read page 17.

Write letter, page 17, three times.

Write short letter home.

LESSON VI

Review page 17.

Write letters, page 18, two times.

Write short letters to friends.

Practice alphabet forward and backward.

Read page 50—addressing envelopes.

LESSON VII

Read page 20.

Write sentences, page 21, three times.

Write short letters to friends.

LESSON VIII

Business letters; read page 30.

Copy letters, page 28, 31, 33.

Write letters to friends.

LESSON IX

Tabulation; copy letter, page 43.

Write letters to friends.

Centering; read page 55.

Copy bottom page 55.

LESSON X

Manifolding; carbon method.

Read bottom page 51, top page 52.

Write letters to friends, making carbon copy.

Test yourself with the following exercise.

TEST EXERCISE

Copy the following page, inserting answers to the questions:

Student's name _____, Date _____

Hospital _____

How many hours have you devoted to this course? _____

How many lessons have you completed in this course? _____

How much typewriting did you know before starting this course? _____

Copy the following at your best accurate speed, recording the time of start and finish:

Time started _____ Finished _____ Total _____

Smith's page 68.

My young friends _____ and efficiency.

Strokes per minute _____ Number of errors _____

NOTE.—The above speed test contains 814 strokes, including spacing, and should be copied in 10 minutes, without more than eight errors.

Rehabilitation monograph. Joint Series No. 12.

Unit Course—Physical Education I—Calisthenics for Curative Purposes

CALISTHENICS FOR CURATIVE PURPOSES

January, 1919—Trial edition

1. *For whom intended.*—The exercises proposed are for that class of patients certified as able to engage in exercise. It may logically include convalescents from injury to bone, muscle, and nerve, or from infectious disease, as pneumonia, or, in instances, heart and tubercular patients.

The process of convalescence from disease or injury is hastened by using at the proper time a judicious selection of exercises which may be taught in class formation, preferably out of doors.

2. *Advantages to be derived by the student.*—These exercises are intended:

(a) To increase the tone of the muscles of the body, including, naturally, the cardiac or involuntary muscles as well as the voluntary.

(b) To restore certain body control, poise, and balance so valuable to the soldier.

(c) To help overcome the tendency to "hospitalization."

(d) As the most important hygienic procedure not provided by the medical or surgical services.

The hospital in its organization will provide all that is essential in proper food, adequate nursing, sanitary control, and skilled medical and surgical attention. Daily exercise of the right kind will give the hygienic benefits of exercise—the removal of waste, the renewal of the lymph and blood supply, the increased tone of the musculature, the feeling of strength and power that results from the performance of physical acts.

3. *The selection of natural movements.*—The most desirable types of physical activity are sports and games in which the individual is freed from all thought of self and engages in activity with an objective in mind. But practically, in a large number of convalescents, we find a decided lack in skill, strength, and even desire for activity. They may be prepared for the playing of games by daily exercise in movements that can be regulated and controlled with reference to their convalescence.

The following arguments have guided the choice of exercises:

(a) The movements which man has made in developing from lower forms of life into the being that he is are more suited to his biologic needs than are the movements which are unrelated wholly to his phylogenetic inheritance.

(b) Formally taught movements which are similar in type and quality to the movements of life are more interesting than movements which are artificial.

(c) Movements should not cause strain or soreness of the part used. That physical education is most scientific which provides increasing amounts of physical activity and hence increasing capacity for activity, without at any time producing soreness, stiffness, and strains. The idea that an exercise must be *felt* in order to be valuable is similar to the idea, and as erroneous, that medicine must have a nasty taste and a mysterious color in order to be potent.

4. *Outline of lessons.*—(1) Standing, (2) stretching, (3) throwing, (4) lifting, (5) climbing, (6) walking, (7) jumping, (8) running.

5. *Points to be remembered in teaching the exercises.*—(a) Teach the exercise at first by imitation, in which the instructor and class perform the exercise. Directions should be given while the instructor and class are in the positions. The learner of the exercise in this way obtains stimuli from his eyes (seeing the instructor), his ears (hearing the directions), and his muscles (kinesthesia, correcting and testing his own position by his other senses).

(b) Teach with enthusiasm. Believe in what you are doing. Have some conviction about the values of the movements.

(c) Indicate in commands the kind of action you want. Don't be phonographic.

(d) Keep clearly in mind the difference between an exercise of "command" and an exercise of "rhythm." Do not confuse them.

(e) Know the exercises so that you do not require a lesson card.

(f) Be as nearly perfect as possible in execution of the exercises yourself.

6. *Progression with natural movements.*—The formal artificial movements of the Swedish and German systems based their progression on anatomic and kinesiological facts. The extended series for several years of school life is not required here. Most patients will be discharged as soon as they have recovered. Moreover, they should be introduced to the game program as rapidly as possible, and with their increased participation in that part of the program their practice in this part may cease.

The lesson, however, provides a physiological progression in proceeding from the simple to the complex, from the easy to the difficult. As the patient grows in endurance, the amount of exercise should be increased and the speed of the movements likewise. Endurance and speed are therefore to guide and are to be emphasized in accordance with the condition of the patient.

7. *Modification of exercises for individual needs.*—In certain patients it will be necessary to modify the lesson. For example, in flat-foot patients with symptoms the jumping exercise should not be used; the carrying exercise must be omitted with certain other orthopedic patients. There is nothing sacred in the lesson. Fit the lesson to the patient and not the patient to the lesson.

8. *Tests to apply in determining value.*—(a) The work is well done if the posture improves. There should be continual emphasis on the up strokes of movement and none on the down. Work for uplift! Even the jumping exercise must be accented upward and the landing should be light and noiseless. With this as a guide the jump will be made only as high as is compatible with this control. Work for the parallel foot position with weight on outer edges of feet.

(b) Is there more control and balance? Increased ability to response to changes in the center of gravity will indicate this control. Is there lagging in the command part of the exercises? Work for alert response, accuracy in movement and control.

(c) Sense of improved well-being will show in the attitude and remarks of your patient. Watch for them. Talk with him.

(d) Rapidity of convalescence should guide. If his convalescence is prolonged, watch for signs of fatigue, breathlessness, and exhaustion. Is he using any more energy in this work than he can spare?

(e) Presence or absence of untoward symptoms. Watch for signs of undue fatigue. Does he seem tired at the end of the lesson? Is he unduly breathless? Is he dizzy? Keep his participation within the limit of his present power.

9. *References.*—(1) Health Exercises for Everyday Use, Lieut. Jesse Feiring Williams, M. C., U. S. A., Teachers' College Record, November, 1918; (2) Diseases of the Heart and Aorta (pp. 185-194), H. O. Hirschfelder, M. D., J. B. Lippincott & Co., 1913; (3)

Reclaiming the Maimed, R. Tait McKenzie, M. D., Macmillan, 1918; (4) Exercise in Education and Medicine, R. Tait McKenzie, M. D., W. B. Saunders, 1916; (5) Ninth Year Book of the V. E. A., T. D. Wood, M. D., Chicago University Press.

LESSON I

STANDING

NOTE.—The following lesson should be taught twice a day and should be of from 20 to 30 minutes' duration. Rest periods must be permitted between each exercise.

The standing exercise is used to help in achieving a good standing posture. Much of the posture work is bad on account of the rigid and unnatural position attained. The body is too frequently put into such a posture that the relation of parts prevents quick and controlled action. One should seek to attain in standing an erect position without rigidity, thus insuring healthful functioning of abdominal organs, proper use of joints, and efficient use of the musculature of the body.

EXERCISE

Stand with the feet parallel to each other and 12 to 18 inches apart. Place one foot (either one) 3 to 4 inches in front of the other. Have weight on both feet disposed to their outer edges. This position of the feet produces balance, pivot, and control. Push the trunk upward and lift the abdominal wall upward. Retain a feeling of relaxation in the shoulders but secure a sensation of extension and lengthening of the body without contracting or tensing the muscles.

GUIDES IN PERFORMANCE

1. Avoid rigidity.
2. Secure straightening of the spine but keep the shoulder muscles relaxed.
3. Keep the weight off the heels.
4. Pull the abdominal wall upward and keep the lower half of the abdominal wall constantly flattened.

COMMAND

For individual performance of the exercises no commands are required. Directions are given, however, for use in group instruction where commands are necessary. The commands have two parts separated by a pause. The length of the pause should vary according to the needs of the group and the exercise. The first part of the command is preparatory; the second is executive. These parts should be spoken in such a way as to convey in the voice the manner of action expected. The command for this first exercise is: "Class—Stand!"

LESSON II

STRETCHING

This is a natural movement that straightens the spine, lifts the chest, and overcomes the sagging of the abdominal muscles so commonly seen in adults.

EXERCISE

On the command "One!" push the arms easily upward and rise on the toes as far as possible. Reach up as far as possible as if trying to get an object from a high place.

On "Two!" let the arms sink and the heels touch the floor, but retain as long as possible the sensation of extension. Do not let the body droop. The development of the proper muscle sensation is important.

GUIDES IN PERFORMANCE

1. Avoid tenseness and rigidity.
2. Do not bend backward.
3. Avoid angular movement of the arms. Do not swing them up; push them up.
4. Perform with a feeling of relaxation rather than contraction.
5. Repeat the movement 10 times. (In the beginning, two or three times is sufficient, for all the movements which are to be repeated.)

6. Do not execute the movement rhythmically for in rhythmical exercises it is more difficult to get the correct form at the end of the movement. The form in this movement is important.

COMMAND

1. *Ready for stretching.*—"Stand!"
2. *Stretching.*—"One!" "Two!"

LESSON III

THROWING

This is a natural movement used by man in throwing a ball at an object. In learning movements that involve complex coordinations, do not think of the end of the movement, but keep clearly in mind the means to that end. Follow closely the directions for arm, leg, and trunk movement, and the coordination will come.

This movement is a powerful trunk exercise. It uses the back and side muscles and brings into play the large muscles of both arms and both legs.

The first part of the movement corresponds to the second part in position of trunk and legs.

EXERCISE

Stand with feet about 24 inches apart and with the left foot about 6 inches in front of the right.

On "One!" clasp hands lightly, waist high; shift weight to the right foot, bend the right knee, draw both hands to the right, twist the trunk to the right, and turn the head to the right. The left leg is straight and relaxed and the left heel is off the floor. The trunk is inclined forward.

On "Two!" throw with the right hand, twisting the trunk sharply to the left. The left knee is bent and the right knee is straight with the heel off the floor. Notice that the body forms a straight line from head to right heel. The weight has been transferred to the left leg. The right arm is forward and the left arm back.

GUIDES IN PERFORMANCE

1. Avoid angles and sharp tensions in the movement.
2. Make all movements flowing, smooth, and harmonious.
3. Avoid conscious contractions. Do not try to contract the muscles. Perform the movement and the muscles will contract to carry out your desires.
4. Repeat the exercise 10 times. At first separate it into two parts. After it is learned make it continuous.
5. After strength and power are developed, the movement may be performed rhythmically 20 times.

COMMAND

1. *Ready for throwing.*—"Stand!" Stand with feet about 24 inches apart and with the left foot about 6 inches in front of the right.
2. *Throwing.*—"One!" "Two!"
3. To command the rhythmical throwing, set the rhythm that is desired. Then command, *Throwing in rhythm*, "Begin!" Count 1, 2, 1, 2, to mark the rhythm.
4. To halt the group, command, "Class—Halt!" inserted in the series of 1, 2.
5. "Class—Stand!" Standing position as given in "Standing" is taken.

LESSON IV

LIFTING

This is a natural movement used in lifting an object from one side of the body to the other, or from a low level to a higher one. It is an exercise of the back and legs and may be made very vigorous by reaching low and lifting high.

The movement as given has two phases—low lifting and high lifting.

EXERCISE OF LOW LIFTING

On command "One!" bend the right knee and reach with arms to the right of the right foot about 12 inches from the floor. The left leg is straight, the back is flat, and the movement occurs in the hip and knee joints. On "Two!" transfer the weight to the left foot and lift the object secured in command "one" to the left and into the same relative position. Then the left knee will be bent; the right leg straight and the arms will be to the left of the foot about 12 inches from the floor.

EXERCISE OF HIGH LIFTING

On "One!" assume the position of low lifting. The hands reach the floor and there is greater bending in the right knee and hip joints. The back remains flat and the left leg is essentially in the same position.

On "Two!" lift the object to the left and place it high above the head. Vigorous muscular extension should occur in this part of the movement while the weight is being shifted to the left foot and the right leg is relaxed with the right heel off the ground.

GUIDES IN PERFORMANCE

1. Avoid tenseness in the movement. Seek smoothness and constantly adjust the body to the different parts of the exercise.
2. Secure uplift of the body in the high lifting and get the complete extension that would come in placing a box on a high shelf.
3. Repeat 10 times with each lift.

COMMAND

1. *Ready for lifting.*—"Stand!" Stand with feet 24 to 28 inches apart parallel and with the weight disposed to their outer edges.
2. *Low lifting.*—"One!" "Two!"
3. *High lifting.*—"One!" "Two!" Start the high lifting part of the time on the left and part of the time on the right.

LESSON V

CLIMBING

Climbing has always played a prominent part in the history of man. Our arboreal ancestors excelled in it and our children to-day, at an early age, seek to recapitulate their racial history in the same action. This movement is a powerful exercise for the legs and secures strong contraction of the abdominal muscles. It represents reaching upward and grasping an object, as a limb of a tree or ladder rung, and pulling up one leg to obtain support preparatory to pushing up the body. The arm movement is identical with the stretching exercise.

EXERCISE

On "One!" reach upward with the arms, raise the right knee forward, and push the body upward on the ball of the left foot. Secure vigorous stretching upward. This is to be the accented part of the movement. On "Two!" return to standing position.

GUIDES IN PERFORMANCE

1. Be careful not to droop on "Two." Keep the erect position.
2. Accent the count "One!"
3. The movement may be performed rhythmically but the rhythm should be slow and the accent always on the upward movement.

COMMAND

1. *Ready for climbing.*—"Stand!"
2. *Climbing.*—"One!" "Two!"

LESSON VI

WALKING

The walking movement represents a natural exercise performed with movement of the opposite arm and leg. The act should be executed with the feet parallel and with the weight on their outer edges.

Walking can be something more than a means of progression. Smooth arm movement and vigorous leg action will bring exhilaration into an act that is frequently rendered difficult by improper habits and clothing.

EXERCISE

On "One!" raise the left knee forward and swing the right arm forward. The body remains poised on the ball of the right foot. On "Two!" reverse the position of arms and legs.

GUIDES IN PERFORMANCE

1. Keep the accent upward.
2. In walking avoid the pounding of the heels on the floor. The heels strike first always, but the accent of the movement should be upward and forward, never downward.
3. This movement is not to be confused with the aimless strolling that is seen so frequently.
4. The rhythmical and continuous walk is used as soon as the idea of the arm and leg movement is comprehended.

COMMAND

1. *Ready for walking.*—"Stand!"
2. *Walking.*—"One!" "Two!"
3. *Walking in rhythm.*—"Begin!" See directions for commanding a rhythmical exercise in "Throwing."

LESSON VII

JUMPING

To clear an obstacle or grasp an object above one's standing reach, one resorts to jumping. This is therefore a natural movement and it should be performed naturally. The first part of the movement uses the muscles of the entire body and in the second part the body is thrown into the air by the vigorous contraction of leg, back, and arm muscles. In the continuous jump, the landing position serves as the start for the next jump. At first the movement should be practiced without the jump.

EXERCISE

On "One!" bend the knee and hip joints and incline the body forward. Swing the arms downward and backward, elevating the heels slightly. The trunk should be inclined and not held in the upright and unnatural position sought in some gymnastic systems. On "Two!" swing arms forward and upward, and spring into the air. The landing follows as a result of the movement and should assume the starting position shown.

GUIDES IN PERFORMANCE

1. At first practice the knee bending and arm swinging without the jump. This should be practiced daily for a week at least. When the jump is used, do not stimulate the patients too much and try to get a high jump. Work for that later.
2. Keep the accent upward. Secure a light landing.
3. Let the trunk incline forward when the knees bend. The angle at the hip joint should equal the angle at the knee joint.

COMMANDS

1. *Preparation to jump.*—"One!" "Two!"
2. *Ready for jumping.*—"One!" "Two!" "Three!"
3. *Continuous jumping.*—"One!" "Jump!" "Jump! Jump!"
4. *Stand.*

LESSON VIII

RUNNING

This is a natural exercise performed on the balls of the feet with vigorous thrusting upward of the knees and free and vigorous swinging of the arms. It will be noticed that the right arm is forward when the left knee is forward. This opposition in walking and running is a fundamental compensation in the movement of the body to secure proper balance, direction, and control. This exercise vigorously stimulates the circulatory and respiratory systems, and will aid in improving all the functions of the organs supplying the body with energy. It should be possible for one to run and enjoy the movement.

EXERCISE

On "One!" swing the right arm forward and thrust the left knee upward and forward, at the same time pushing the body upward on the ball of the right foot.

On "Two!" reverse the position of the arms and legs and push the body up on the ball of the left foot.

GUIDES IN PERFORMANCE

1. Run a few times at first. After power and endurance are developed, the run should be continued for several minutes.
2. Accent the upward movement. Do not strike the floor hard on the down stroke.
3. After the coordination is learned, the run should be executed in rhythm.

COMMANDS

1. *Ready for running.*—"Stand!"
 2. *Running.*—"One!" "Two!"
 3. *Running in rhythm.*—"Begin!"
- See directions for rhythmical movements in "Throwing."

Rehabilitation monograph. Joint Series No. 13.

Unit Course—Arithmetic I—Teacher's manual

FOR MEN OF LIMITED ELEMENTARY EDUCATION

January, 1919—Trial edition

1. QUALIFICATIONS OF STUDENT

This course is intended for two groups of men: First, those who have had practically no training in number work, and second, those who have studied only the fundamental operations. For the first group the course provides an introduction to arithmetic; for the latter group it furnishes review of the fundamental operations and advanced instruction in fractions and decimals.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

At the end of this course the student should have a practical knowledge of the fundamental processes in whole numbers, fractions, and decimals.

Problems will be selected from the student's actual experience to illustrate the various processes. The different mathematical operations will be presented under conditions similar to those that confront him in life.

3. LENGTH OF COURSE

This unit course is divided into 24 assignments. The average student should complete each assignment in one hour. The time assignment may be varied, however, to suit individual conditions.

4. EQUIPMENT AND MATERIALS

Paper: Unruled, 6 by 9 inches.

Pencils: Soft lead.

Blackboards.

Rulers.

Textbooks:

Essentials of Arithmetic, Primary Book I.

Essentials of Arithmetic, Intermediate Book II.

Wentworth-Smith, Ginn & Co., New York City.

Primary Arithmetic I.

Intermediate Arithmetic II.

Samuel Hamilton, American Book Co., New York City.

Arithmetic for Evening Schools.

William E. Chancellor, American Book Co., New York City.

Woody Tests in Arithmetic, Series B.

Clifford Woody, Teacher's College, Columbia University, New York.

Courtis Standard Practice Tests.

World Book Co., Yonkers, New York.

One hospital outfit of the Courtis tests will consist of:

10 envelopes A.

10 envelopes B.

15 pads.

2 manuals.

Arithmetic tests in fundamental operations, fourth to eighth grade.

Use these Courtis tests as teaching aids and for test purposes. These lesson sheets and tests were made for children, but they may be used successfully for adults.

While an abundance of problems have been given in the various references, the teacher should seek problems which are applicable to the particular field with which the student is acquainted. Vary the problems according to the student's ability.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

Upon completion of this course, the student should be able to do number work involving the fundamental operations, fractions and decimals, with accuracy and speed. He should be skillful in solving problems of everyday affairs, involving the different processes.

Men whose early school training has not gone beyond the third or fourth grades should be expected, at the end of this course, to attain a skill in addition, subtraction, multiplication and division represented by the sixth grade standard on the Woody Arithmetic Test, Series B. This would mean that in addition the men should be able to work out 16 problems correctly; in subtraction, 12 problems; in multiplication, 15 problems; and in division, 10 problems, in the specified time.

Accurate reports of first and final tests will be valuable in revising this course. Take them carefully and report them in the records.

The Courtis Standard Practice Tests should be given throughout the course. No better incentive for progress can be offered to a student than the definite knowledge of his rate of improvement as shown by the results of the tests.

The final rating for this course may be given on a percentage scale, determined by a test similar to the following. No student should be given a certificate for this course if he can not attain a rating of 70 per cent on this test in 15 minutes:

I. Add 4, 076

927

8, 503

49

9, 681

II. Subtract 7, 403

5, 869

III. Multiply 947

68

IV. $49\overline{)60,348}$ V. Add $7\frac{1}{2}$ $5\frac{7}{8}$ $14\frac{3}{4}$

VI. Out of his salary of \$30 a soldier must pay \$7.10 for insurance, \$10 allotment, \$2 for Liberty bonds, and \$1.60 for a pane of glass which he broke. How much does he have left?

VII. In a company of 360 men one-fifth were killed in battle. How many were left?

VIII. If a uniform costs \$14.75, what will it cost for uniforms for a company of 280 men?

IX. A basket containing $3\frac{1}{4}$ pounds of meat and $2\frac{1}{2}$ pounds of sugar weighs $6\frac{7}{8}$ pounds. What is the weight of the basket?

X. What is the cost of a piece of land 48 feet wide and 90 feet long at \$6.25 a square foot?

Outline of lessons

LESSON I

Topic	Page	Book
Numeration and notation.....	5	Chancellor.
Addition.....	30, 37	Wentworth-Smith, I.
	6, 7	Chancellor.
	31, 48	Hamilton, I.
Writing and adding money.....	112, 113, 118	Wentworth-Smith, I.

LESSON II

Subtraction.....	33	Hamilton, I.
	66, 67	Wentworth-Smith, I.
	8	Chancellor.

LESSON III

Subtraction.....	69	Wentworth-Smith, I.
	53	Hamilton, I.
Making change and subtracting money.....	121, 122, 123	Wentworth-Smith, I.

LESSON IV

Multiplication.....	56, 59, 61	Hamilton, I.
	85-87	Wentworth-Smith, I.
The instructor must select those types of illustrative problems which appeal to the individual man because of their direct correlation with his special vocational interests.		

LESSON V

Multiplication.....	143, 180	Wentworth-Smith, I.
	9	Chancellor.
	161	Hamilton, I.
Multiplying money.....	172, 173	Wentworth-Smith, I.

Outline of lessons—Continued

LESSON VI

Topic	Page	Book
Short division.....	128, 129 73, 74, 75	Wentworth-Smith, I. Hamilton, I.

LESSON VII

Short division.....	133, 187, 188 101, 105, 147, 156, 157 80, 81	Wentworth-Smith, I. Hamilton, I.
Measures.....		Hamilton, I.

LESSON VIII

Long division.....	191, 192, 193 165, 167	Wentworth-Smith, I. Hamilton, I.
Introduce long division by having 1 in the unit's place of the divisor, as 879÷21, 588÷31.		

LESSON IX

Long division.....	194, 195 168, 169	Wentworth-Smith, I. Hamilton, I.
Measures.....	82, 83, 84	Hamilton, I.

LESSON X

Long division.....	10 196	Chancellor. Wentworth-Smith, I.
Dividing money.....	198	Wentworth-Smith, I.
Courtis Standard Practice Tests: Lessons 8, 9, 10, 11, 12, 13.		

LESSON XI

Review and application of fundamental operations—Problems selected from.....	132, 136, 176 197, 218 13	Hamilton, I. Wentworth-Smith, I. Chancellor.
Select simple applications, avoiding involved problems and ones in which the nonmathematical content is strange to the student. Concentrate upon the mathematical difficulties.		

LESSON XII

Common fractions.....	22, 23, 24 47, 48, 49 11	Hamilton, II. Wentworth-Smith, II. Chancellor.
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LESSON XIII

Reducing fractions.....	50-57 31, 32, 33	Wentworth-Smith, II. Hamilton, II.
Do not give any fractions that can not be reduced by inspection.		

LESSON XIV

Adding fractions.....	35, 36, 37 61, 62 17	Hamilton, II. Wentworth-Smith, II. Chancellor.
In addition and subtraction of fractions, use simple fractions which will permit the student to obtain the L. C. D. by inspection. The simple fractions, as $\frac{1}{2}$, $\frac{3}{4}$, $\frac{1}{6}$, $\frac{2}{6}$, $\frac{3}{8}$, are the ones the student will use in his daily experiences.		

LESSON XV

Subtracting fractions.....	63, 64, 65 37-41	Wentworth-Smith, II. Hamilton, II.
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Outline of lessons—Continued

LESSON XVI

Topic	Page	Book
Subtracting fractions.....	18	Chancellor.
Problems: Addition and subtraction of fractions.....	67 41-43	Wentworth-Smith, II. Hamilton, II.

LESSON XVII

Multiplication of fractions by whole numbers.....	70, 71 43-46	Wentworth-Smith, II. Hamilton, II.
Use simple fractions in multiplication and division of fractions, never employing fractions like $\frac{7}{17}$ or $\frac{1}{18}$.		

LESSON XVIII

Multiplication of fractions by fractions; multiplication of mixed numbers.....	71-74 48, 49, 50, 54, 55 19	Wentworth-Smith, II. Hamilton, II. Chancellor.
If necessary, special attention may be given to the study of cancellation as a short-cut method. See Wentworth-Smith II, pp. 96, 97, and Hamilton II, p. 139.		

LESSON XIX

Division of fractions.....	82-89 57-65 20	Wentworth-Smith, II. Hamilton, II. Chancellor.
Select very simple examples in the division of fractions.		

LESSON XX

Reading and writing of decimals.....	141, 142, 143 72-75 25	Wentworth-Smith, II. Hamilton, II. Chancellor.
The writing of decimals should be based on United States money. Limit it to ten thousandths. Show how to write decimals as fractions and per cents.		

LESSON XXI

Addition and subtraction of decimals.....	147-149 77-80 26-27	Wentworth-Smith, II. Hamilton, II. Chancellor.
These operations should be based on United States money.		

LESSON XXII

Multiplication of decimals, including finding per cent of money	150-157 81, 82, 83 28	Wentworth-Smith II Hamilton, II. Chancellor.
Courtis Standard Practice Tests, Lessons 27, 28, 29, 30, 31.		

LESSON XXIII

Division of decimals.....	166-171 84-87 29	Wentworth-Smith, II. Hamilton, II. Chancellor.
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LESSON XXIV

Problems in decimals.....	175-177	Wentworth-Smith, II.
Select simple applications.....	88-91 30	Hamilton, II. Chancellor.
Woody, Arithmetic Tests, Series B. Give the test carefully and compare with the student's initial record. It will be interesting to see what progress has been made in such a short intensive course.		

Rehabilitation monograph. Joint Series No. 14.

Unit Course—Arithmetic II

FOR MEN WITH LIMITED COMMON-SCHOOL EDUCATION

January, 1919—Trial edition

PART I—TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is intended for those men who have not had any training in arithmetic beyond the sixth grade of the elementary school, who have been long out of school and have forgotten much of their training. These men will need a review of the fundamental processes, simple fractions and decimals, and advanced instruction in percentage and its applications, measurement, and interest.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

At the end of this course the students should have a thorough and practical knowledge of the fundamental operations of fractions, decimals, and percentage. The purpose will be to present only the essential arithmetical processes and to emphasize the application of these essentials to the social and business life of the men.

3. LENGTH OF THE COURSE

This unit course is divided into 24 assignments. The average student should complete each assignment in one hour. However, the time assignment may be varied to suit individual conditions.

4. EQUIPMENT AND MATERIALS

Paper—Unruled 6 by 9 inches.

Pencils—Soft lead.

Blackboards.

Rulers.

Textbooks:

Essentials of Arithmetic—Intermediate book (W. S. int.).

Essentials of Arithmetic—Advanced book (W. S. adv.).

Wentworth-Smith, Ginn & Co., New York City.

Durell's Advanced Arithmetic (D).

Fletcher Durell, Charles E. Merrill Co., New York City.

Woody Tests in Arithmetic, Series B.

Clifford Woody, Teachers College, Columbia University, New York.

A Community Arithmetic (H).

Brenelle Hunt, American Book Co., New York.

Courtis Standard Practice Tests.

World Book Co., Yonkers, N. Y.

One hospital outfit of Courtis Standard Practice Tests will consist of—

10 envelopes A.

10 envelopes B.

15 pads.

2 manuals, Arithmetic Tests in Fundamental Operations, Fourth to Eighth Grade.

Use these Courtis tests as teaching aids and for test purposes. These lesson sheets and tests were made for children but they may be used successfully with adults.

While an abundance of problems has been given in the various references, the teacher must present those problems which are applicable to the particular occupation with which the student is acquainted. Vary the problems according to the student's ability and future needs.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

The student should be able, upon completion of this course, to handle, with accuracy and facility, number work involving the fundamental processes, fractions, decimals, and percentage. He should be skillful in solving problems of every-day affairs involving the different operations.

The student should be expected to attain a skill in addition, subtraction, multiplication, and division represented by the eighth grade standard on the Woody Arithmetic Test, Series B. This would mean that he would be able to work out correctly in the specified time 18 problems in addition, 14 problems in subtraction 18 problems in multiplication, and 14 problems in division. This test should also be given at the beginning of the course in order to permit the teacher to locate the weaknesses of the individual students. Accurate reports of first and final tests will be welcome in revising this course. Take them carefully and report them in the records.

Several testing exercises should be given throughout the course. No better incentive for progress can be offered to a student than the definite knowledge of his rate of improvement as shown in the results of the tests.

The final rating for this course may be given on a percentage scale, determined by a test similar to the following. No student should be given a certificate for this course if he can not attain a rating of 70% on this test in 15 minutes.

I. Add 4869	II. Subtract 485302	III. Multiply 8057
583	396574	39
7064	<hr/>	<hr/>
58		
976		
<u>6391</u>		
<hr/>		
IV. 69)45083	V. Add $8\frac{1}{2}$	
	$7\frac{3}{4}$	
	<u>$14\frac{5}{8}$</u>	

VI. In a company of 240 soldiers, 15% were killed in battle. How many were left?

VII. A farm cost me \$3,500.00. I sold it, making a profit of 18%. How much did I make? What did I receive for the farm?

VIII. I bought some furniture for \$475.00. Because I paid cash, I received a discount of 8%. How much did I pay for the furniture?

IX. I bought \$200.00 worth of Liberty bonds paying $4\frac{1}{4}\%$ interest. What interests will the bonds pay in $3\frac{1}{2}$ years?

X. How many cubic feet of dirt would be required to fill up a trench 138 feet long, 4 feet wide, and 6 feet deep?

Outline of assignments

ASSIGNMENT I

Topic	Page	Book
Addition.....	21-24	D.
Subtraction.....	26-28	D.
Multiplication.....	32-34	D.
Woody Tests in Arithmetic, Series B.		

ASSIGNMENT II

Long division.....	39, 40	D.
Short method in multiplication and division.....	11, 17	W. S. adv.
Industry Review: Telegraph and telephone.....	64-66	D.
Select simple applications; avoid involved problems.		

ASSIGNMENT III

Addition and subtraction of fractions.....	21, 23 77-80	W. S. adv. D.
Use simple fractions which will permit the student to obtain the L. C. D. by inspection. Fractions $\frac{1}{2}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{1}{6}$, $\frac{3}{8}$ are the ones the student will use most frequently in his daily experiences.		

ASSIGNMENT IV

Multiplication of fractions.....	22, 23 81-85	W. S. adv. D.
Do not select examples which involve unusual fractions, as $\frac{1}{13}$, $\frac{9}{11}$, $\frac{1}{325}$. If necessary, special attention may be given to the study of cancellation as a short-cut method. See D, page 55, and W. S. int. pages 96, 97.		

ASSIGNMENT V

Division of fractions.....	22, 23 86-89	W. S. adv. D.
Industry review: Government activities.....	98-102	D.
Select the simple problems.		

ASSIGNMENT VI

Long and square measures.....	143-145 108, 109	D. W. S. int.
The instructor must select those types of illustrative problems which appeal to the individual man because of their direct correlation with his special vocational interests. For suggestions on problems see Book D, pages 179-212.		

ASSIGNMENT VII

Decimals—Numeration and notation.....	103-107	D.
Decimals—Addition and subtraction.....	108-112	D.
These operations should be based on United States money.		

ASSIGNMENT VIII

Decimals—Multiplication and division.....	112-117 9, 16, 24	D. W. S. adv.
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ASSIGNMENT IX

Aliquot parts.....	10 123-125 136-139	W. S. adv. D. D.
Industry review: Railroads.....		
The student should receive daily drill work on the table of fractional equivalents. See D, page 123, and W. S. adv., page 10.		

Outline of assignments—Continued

ASSIGNMENT X

Topic	Page	Book
Cubic measure..... See note to Assignment VI.	112 146, 147	W. S. int. D.

ASSIGNMENT XI

Tables of weight.....	113 141, 142	W. S. int. D.
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ASSIGNMENT XII

Liquid and dry measures..... Courtis's Standard Practice Tests. Lesson No. 13, Test A.	114, 115 147, 148	W. S. int. D.
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ASSIGNMENT XIII

Percentage—Case 1..... Select simple applications, avoiding involved problems and those in which the nonmathematical content is strange to the man. Concentrate upon the mathematical difficulties.	81, 82 216, 221	W. S. adv. D.
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ASSIGNMENT XIV

Percentage—Case 2..... Cases 2 and 3 are relatively much less important than Case 1.	85-87 224-226	W. S. adv. D.
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ASSIGNMENT XV

Percentage—Case 3..... Select the simple and direct cases in profit and loss examples	88, 89, 228 229, 230, 239 240, 241	W. S. adv. D.
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ASSIGNMENT XVI

Discount.....	95-97 241-243	W. S. adv. D.
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ASSIGNMENT XVII

Bills with discount.....	99, 100, 102 125, 128 161, 162	W. S. adv. D. H.
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ASSIGNMENT XVIII

Commission and brokerage..... Select the simple and direct cases. Courtis's Standard Practice Tests. Lessons 30, 31, test B. Compare the results with the records in Assignment XII.	244-247 21, 211	D. H.
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ASSIGNMENT XIX

Taxes—Municipal and income..... Give a brief explanation of the methods of computing each kind. Attempt to show only the principle of taxation, because the rates will change rapidly in the next few years.	169-173 178-185 248-251	W. S. adv. H. D.
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Outline of assignments—Continued

ASSIGNMENT XX

Topic	Page	Book
Insurance.....	178-182 254-257	W. S. adv. D.

ASSIGNMENT XXI

Simple interest.....	103, 104 270-274	W. S. adv. D.
Illustrate with several problems involving Liberty bond transactions. Avoid all unusual rates and times.		

ASSIGNMENT XXII

Simple interest.....	105, 106, 107 247-279	W. S. adv. D.
Teach direct case only. Courtis's Standard Practice Tests, Lesson 44, Test C. Compare the results with the records in Assignments XII and XVIII.		

ASSIGNMENT XXIII

Savings banks.....	135-141 309, 310 218-240	W. S. adv. D. H.
Explain briefly the system operating in cooperative banks, building and loan associations, and postal banks.		

ASSIGNMENT XXIV

Investing money—Stocks, bonds, mortgages.....	189-197 258-262, 312 246-258	W. S. adv. D. H.
Woody Tests in Arithmetic, Series B.		

Rehabilitation monograph. Joint Series No. 15.

Unit Course—Machine Shop Practice I

STRAIGHT TURNING BETWEEN CENTERS

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF THE STUDENT

The unit in straight turning between centers is intended for those who have had no experience on the engine lathe but who have a desire to become engine-lathe operators or to prepare for general machine work. Students should be capable of following simple oral and printed instructions and be familiar with the elementary processes in arithmetic.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

The unit course is intended to serve as a foundation for subsequent courses in machine-shop practice. The engine lathe is the fundamental machine in the modern machine shop, and the man who understands the lathe can readily master any of the other machines in common use.

3. APPROXIMATE TIME REQUIRED

The student should be able to master the work of this course in 25 to 30 hours of study and practice. More practice will give increased accuracy and speed.

It is of prime importance that the student not only be taught the proper use and care of all machines and tools but that he take such care of them when he uses them. "Safety first" methods should also be strongly impressed on him.

Judgment will have to be used as to the limit of accuracy and the time necessary for each exercise. Always bear in mind that the student is being trained for future work, and he must be taught right principles and approved shop methods if he is to compete with other workmen in industry. For this reason do not hesitate to have him repeat a job if it is not up to what you think it should be.

Make sure, by frequent questions, that the student understands the reasons for the methods used. Check his work in his presence and explain the criticisms you make.

Impress on him the cost of stock and materials used so that he may know the importance of the conservation of such material. Many mechanics spoil or waste material without knowing its value or caring for it.

In Lesson 4 the $\frac{5}{8}$ -inch bolt with square head is made from 1-inch square stock. This is not the commercial practice, but the man is the object, not the bolt. The length of the bolt may vary as desired. When the bolt is turned to the correct diameter, it will be laid aside to be used later in the unit on thread cutting.

The center punch in Lesson 5 may become the property of the student. The tempering may be done by the instructor or any other person familiar with the process.

4. EQUIPMENT NECESSARY

The following equipment is recommended as being adequate for this course:

Engine lathe, 14 inches by 6 feet is a desirable size.

Set of lathe tools or patent tool holders.

Outside and inside calipers, 5-inch.

Steel scale, 6-inch, No. 4 graduation.

Center gauge.

Lathe file, 12-inch mill, bastard.

Dogs for driving the work, selected according to the size of work.

Six-inch monkey wrench, or dog wrench.

Hack saw, 10 or 12 inch.

Tools used for centering work but not included in above list: Hermaphrodite calipers, 5-inch; center square; surface gauge; bell center; V-block; center punch; hammer; sensitive drill press with chuck, or speed lathe fitted with drill chuck, or centering machine.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the work of the course. Duplicates of all certificates granted will be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each job, project, or lesson performed by the student throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating of the work of students be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*; while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor, nor should this rating be influenced by personal feelings, such as dislike or grudge. In order that the rating may be just and of value both as a credential for the student and a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- (1) Execution of work:
 - (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
 - (b) *Technique*.—Does the student use workmanlike methods?
Does he exercise reasonable economy in use of materials?
Is he neat and orderly in care of tools?
- (2) Finished product:
 - (a) *Accuracy*.—Should be determined by the record kept of errors in measurement, fit, etc.
 - (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (3) Interest:
 - (a) *Attitude toward work*.—Does the student love his work or does he watch the clock?
Is he likely to continue in this line of work?
 - (b) *Studiosness*.—Does the student show disposition to study the printed literature related to his work?
Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) *Possibilities of growth*.—Is the student likely, in due time, to receive promotion to positions of greater responsibility?

6. OUTLINE OF LESSONS

Lesson 1.—The lathe, directions for work.

Lesson 2.—Centering.

Lesson 3.—Turning shoulder bolt.

Lesson 4.—Making bolts with square heads.

Lesson 5.—Making center punch.

7. SUGGESTIONS FOR INSTRUCTORS

The exercises suggested are designed to teach the fundamental principles of lathe work. Whenever possible, however, have all exercises lead toward the completion of machines or parts which have some value in themselves. This may be done more easily as the student becomes more proficient in the use of the lathe.

It is estimated that the work of this unit may be done in 30 hours. This is determined largely by the student himself. Some may take much longer. Hence individual instruction should be given at all times, so far as it is practicable.

Encourage the student to work on the machine whenever he has spare time at his disposal after he has completed his unit. Skill in the operation of the various machines comes only by practice and it is to the student's advantage that he acquire as much skill as possible before he quits the course.

Encourage the student also to study the references given and others that you may supply. The more general and technical information he gets, the better mechanic he should be. It will not be possible to enter into a detailed study of all the technical information that would be of value, but much of it can be given from time to time as questions are raised by the student about his work.

Use drawing as much as possible in your work whether it be mechanical, drawing on the blackboard, blueprint, or free-hand shop sketches. Encourage the student to make shop sketches of his work. The drawing by the instructor should always be correct as to principle so that the student may become familiar with mechanical drawings. Ability to read drawings should be cultivated as much as possible.

8. REFERENCES

International Correspondence School Texts. Lathe Work, Sections 15-20, International Text Book Co., Scranton, Pa. (This is a text written for the beginner, well illustrated and clear in explanation.)

Machinery Handbook, Industrial Press, New York. \$6. (One of the standard reference books on shop work.)

American Machinists' Handbook, McGraw-Hill Book Co., New York. \$3. (A standard reference book for use by machinists.)

First Year Lathe Work, 10 cents; How to Run a Lathe, 10 cents. South Bend Lathe Works, South Bend, Ind. (Small instruction books on the lathe with directions for making a small bench grinder.)

The Starrett Book. L. S. Starrett Co., Athol, Mass. 75 cents. (A good book for apprentices and others in machine work.)

Starrett's General Catalogue. L. S. Starrett Co., Athol, Mass. (Small tools, calipers, scales, gauges, etc.)

Micrometer Catalogue and Measuring Book, No. 15. J. T. Slocomb Co., Providence, R. I. (Good instructions on reading micrometers, verniers, and accurate measuring.)

PART 2. STUDENT'S INSTRUCTION SHEETS

GENERAL DIRECTIONS TO STUDENTS

The student should realize that a lathe is an expensive tool which can be easily injured. Care must be exercised in using the lathe to see that it is handled properly.

On going to a lathe that has been used by another man, be sure to turn the spindle by hand and make certain that everything is free before throwing on the power.

Lesson I.—Study of lathe

1. Read:

I. C. S. Lathe Work, sec. 15, pp. 2-29. South Bend Lathe Book, "How to Run a Lathe," pp. 4-8.

American Machinists' Handbook, pp. 616-619.

Dictionary of Shop Terms. American Machinists' Handbook, pp. 563-656.

CAUTION

Do not start the lathe by power during this lesson.

2. *Locate the following parts.*—Back gear, stud, lead screw, apron, tool post, tool post chip, head stock spindle, reverse gears, compound rest, split nut, horizontal feed clutch handle, feed rod, cross feed clutch handle, carriage lock screw, tail stock hand-wheel, live center dead center, face plate, tail stock, spindle lock, saddle, face-gear lock.

Lesson II.—Centering

1. Read:

I. C. S. Lathe Work, sec. 17, pp. 14-21.

The most common method of centering work for turning in the lathe is with hermaphrodite calipers, as shown in figure 1.

2. *Laying out the center.*—The ends of the work are chalked. The caliper is opened to approximately half the diameter of the piece and three or four short arcs described on the end of the piece as shown in the figure. The intersection of these arcs shows the center. If they do not intersect exactly, the center can readily be located by the eye or by resetting the calipers.

The experienced machinist will "pop the center"—that is, by training he can place the center punch very accurately by eye. A light blow with the hammer is given and if the mark does not look right it is "drawn" slightly as shown in I. C. S. Lathe Work, section 17, page 17, paragraph 34. This saves time and a man soon becomes very expert in this method.

Figure 2 shows another method of using the hermaphrodite calipers in centering a piece.

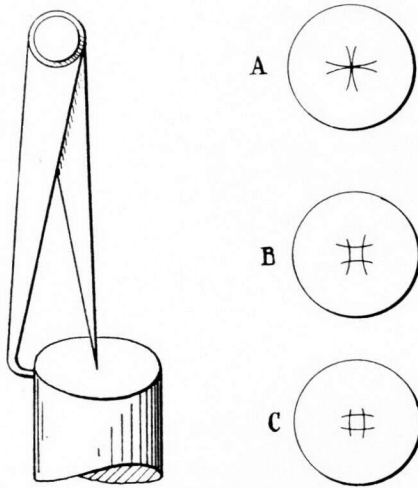


FIG 1.—Centering

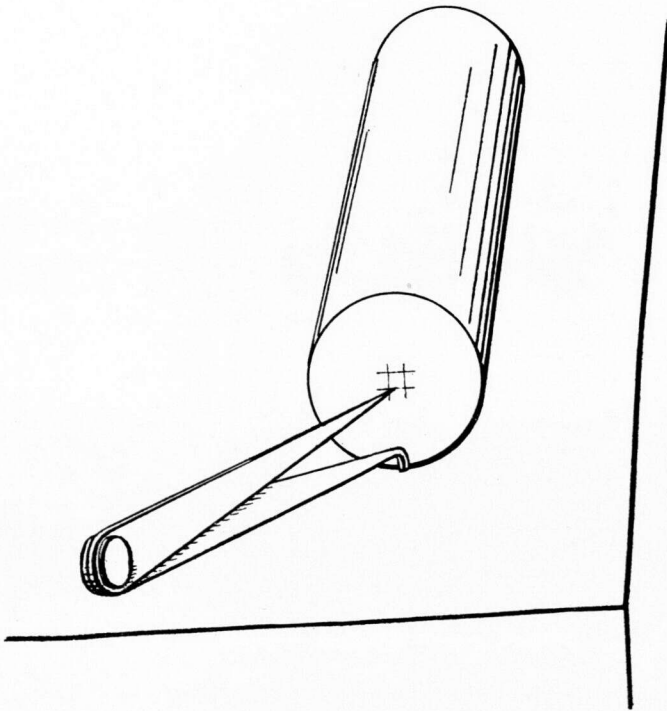


FIG. 2

Figure 3 shows the use of a surface guage and V blocks in centering work.

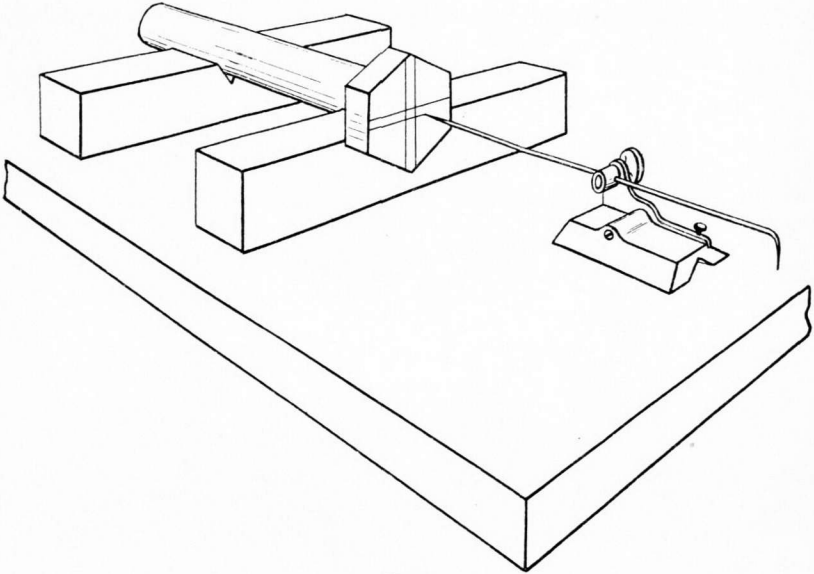


FIG 3

Figure 4 the use of the bell center and the errors due to incorrect use.

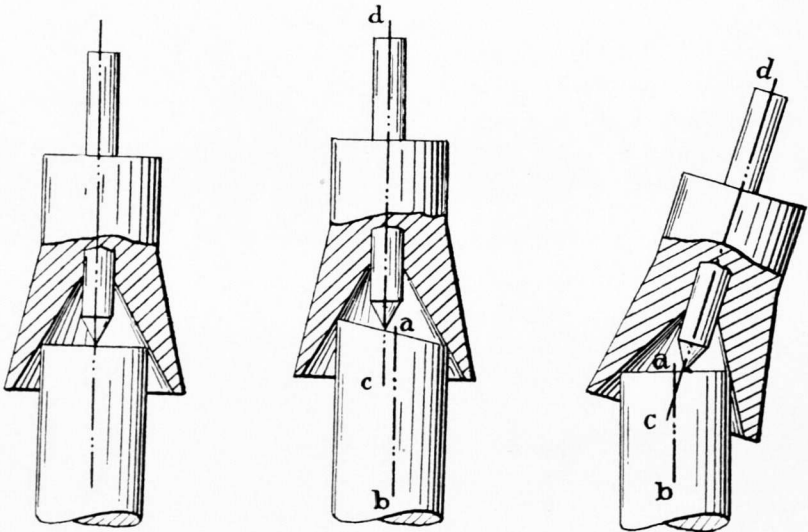


FIG. 4.—Bell-center punch

After using the method best adapted to the work in hand it is necessary to mark the center permanently with a center punch. This gives a start for the center drill.

3. *Center drilling.*—This may be done by the use of a small drill (about 3/32 inch) followed by a countersink, or by using a combination drill and countersink. The standard angle for lathe centers on small lathes is 60°, and the centers in the work should be the same angle.

Care should be exercised in forming these centers, as it is very bad practice to have an unnecessarily large center in small work or small centers in heavy work.

This center drilling may be done on any convenient machine, usually a sensitive drill press, a speed lathe provided with a drill chuck, or on a special "centering machine."

4. *Driving devices.*—There are several ways of driving work between centers. The most common is some form of lathe dog. The common forms of dogs are known as bent tail, single straight tail, double straight tail, and clamp dog. Other special forms of drivers will be discussed later. (See I. C. S. Lathe Work, sec. 15, p. 22.)

5. *Placing work on centers.*—After drilling and thoroughly cleaning both center holes the work is ready for the lathe. A dog is slipped on one end of the work and the screw tightened; some machine oil or a mixture of oil and white lead is put in the center hole of the other end. The work is placed on the live center with the tail of the dog in the face plate slot. The tail stock is adjusted to hold the work. In adjusting the tail stock on the lathe bed it should be clamped in a position that will not require the spindle to be run out very far to reach the

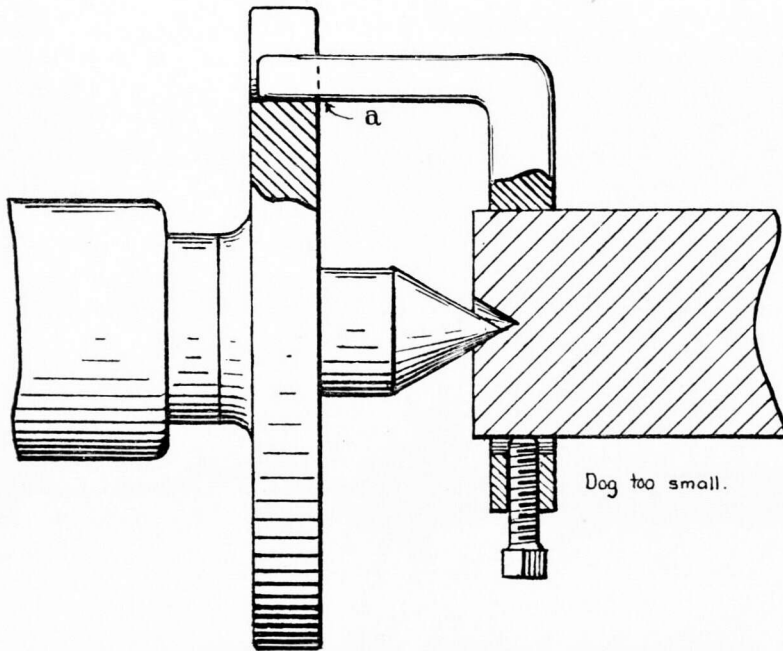


FIG. 5

work. This insures maximum rigidity. Care must be taken not to jab the end of the work with the dead center. Adjust the dead center so that the work is free to turn and at the same time is held so tightly that there is no lost motion. The operator must also see that the tail of the dog fits loosely in the slot of the face plate. Sometimes the dog is too small and the tail of the dog bottoms in the face plate slot. This holds the work away from the live center as shown in Fig. 5. The work is thus prevented from running true.

6. Questions

- (1) How can the lathe be locked so the face plate or chuck can be loosened most easily?
- (2) What would happen if two feeds were put in gear at the same time?
- (3) Is there any way to prevent this being done?
- (4) How many speeds are available on a lathe with a 4-step cone pulley?
- (5) Why is the reverse pulley on the line shaft larger than the other pulley?
- (6) Where is the split nut? What is it for?

(7) Why is the screw cutting feed always driven by gearing while the turning feeds may be driven by a belt?

Lesson III.—Turning a blank “shoulder bolt”

1. *Cut off the stock.*—Always cut stock from $\frac{1}{16}$ to $\frac{1}{8}$ inch longer than the required length to allow for finishing the ends.
2. *Center* as directed in Lesson I.
3. *Put on the dog* and adjust between centers.

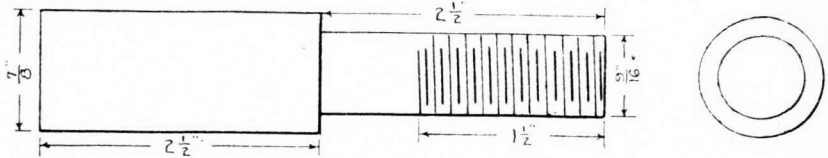


FIG. 6.—Shoulder bolt

4. *Select a right-hand side tool* for facing the end of the work. This is called a right-hand tool because it is used to work on the right-hand end of the piece, or the right side of a shoulder. This tool is set in the lathe, with the cutting edge on a level with the lathe center, as shown in Figure 7.

The tool is fed into the work until the tool is cutting deep enough to finish the end true. Then it is fed out radially by means of the cross slide screw. This will leave a burr at the center. To remove this burr set the tool as in Fig. 8, loosen the tail-stock spindle enough to allow the point of the tool to cut into the center hole, and feed by hand in the direction of the arrow.

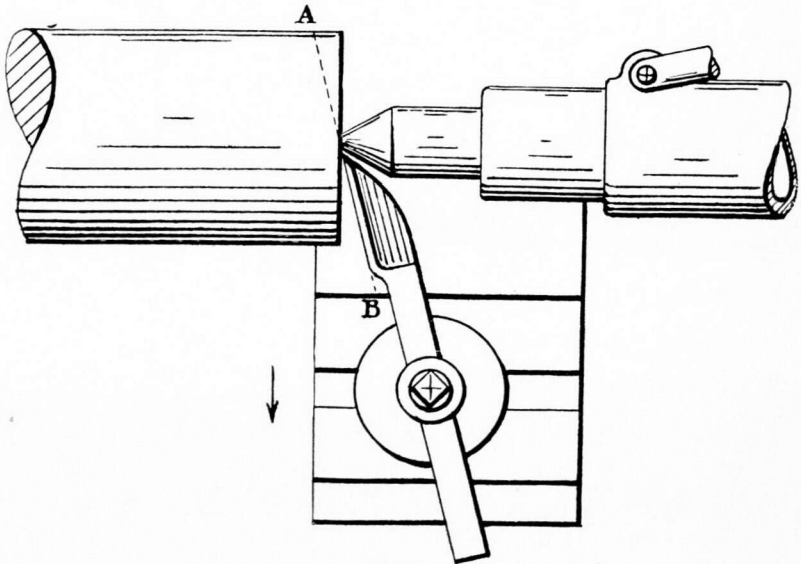


FIG. 7

5. *The piece is now turned end for end* and faced to the required length, 5 inches. If the stock being worked on is cast iron or other material that has a hard scale, a round nose tool should be used first to cut under and break the scale. The side tool is used to finish the operation.

6. *Turning the cylindrical surface.*—This is usually accomplished by some form of a round nose tool. Patent tool holders are often used because they save the expense of redressing and avoid the large amount of expensive steel required for solid tools. A common form is shown in Figure 9.

7. *Set the tool for turning.*—The round nose tool is set approximately perpendicular to the work and as far above the center line as the diameter of the work and the clearance of the tool will permit, and still have the cutting edge in contact with the work.

8. *Make a roughing cut* over the entire length of the piece before any finishing is done. Turn the large end of the bolt ($\frac{7}{8}$ -inch diameter) first, so that if there is a mistake in calipering the first size the bolt may be reversed and the student have another chance to get the correct size.

9. *Calipering.*—I. C. S. Lathe Work, sec. 17, paragraphs 58, 61, and 62.

The outside calipers are set to the exact size, $\frac{7}{8}$ inch, by the steel scale. This is most easily done by putting one leg of the calipers against the end of the scale and near one corner.

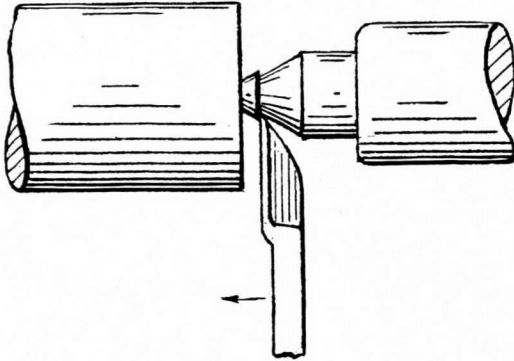


FIG. 8

Open or close the calipers until only half the width of the $\frac{7}{8}$ -inch graduation line shows between the caliper legs. The line between the two legs of the calipers must be parallel with the edge of the scale to get a correct setting. After a little practice a man can set calipers by the scale within a very few thousandths of an inch. The calipers are not sprung when set to size on the scale. Therefore, they must not be sprung by forcing them over the work when testing it for size. This means that they must be held lightly and the "touch" be as delicate as possible. Calipering is an art to be cultivated. Caliper any finished piece, then put a single piece of cigarette paper under one leg of the calipers and note the difference in "feel." The thickness of the cigarette paper is very close to $\frac{1}{1000}$ inch. This is easily detected by

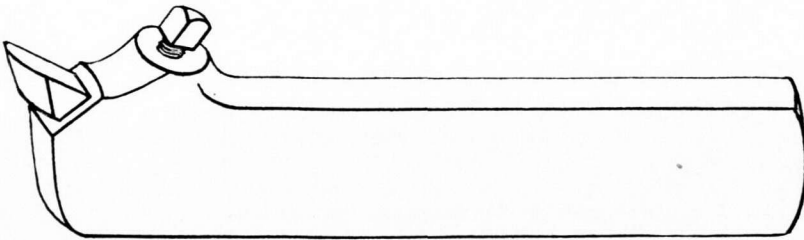


FIG. 9

one who has educated his touch. As soon as a roughing cut is taken over the piece, test with calipers to see if it is cutting parallel. If it is not, adjust the tailstock.

10. *Finish.*—After roughing all over, the diameter of the work can be brought to a caliper size by a series of short trial cuts at the end of the piece. (See I. C. S. Lathe Work, sec. 17, p. 29, par. 59.) When the proper size is obtained the cut is continued the desired distance along the piece. The rough calipering may be done with the lathe in motion, but all close calipering must be done while the work is not revolving. If both caliper legs touch the work, but so lightly that the friction will not support the weight of the calipers, the diameter will be found to be very near the size for which the calipers are set. Cultivate a delicate touch and accurate setting of calipers.

11. Turn the $\frac{9}{16}$ -inch end of the work, using the same method as just described, to a point about $\frac{3}{8}$ inch less than the required length of $2\frac{3}{4}$ inches. The side tool is then used as in facing the ends and the shoulder is squared out to the required length.

Great care must be taken in doing this work to make the shoulder square and to see that the pressure on the tool does not cause it to spring and reduce the $\frac{9}{16}$ inch diameter. (Don't cut a "necktie" around the piece.) This piece is to be kept for thread cutting a little later.

Questions

Why is it best to take a roughing cut over the entire piece before any finishing is done?

What precautions should be taken in placing work between centers?

Why is it necessary to have the bottom of the center holes in work deeper than the point of the lathe center?

If a piece that has been turned for part of its length is reversed, the turned part often does not run true. If this happens, where do you look for the trouble?

Lesson IV.—A pair of blank milling-machine bolts

As the bolts are to be short, we can make two together and then cut them apart.

1. *Determine the length of stock.*—In this problem we will make a pair of bolts to clamp the dividing head to the platen of the milling machines. The T-slot where the head of the bolt

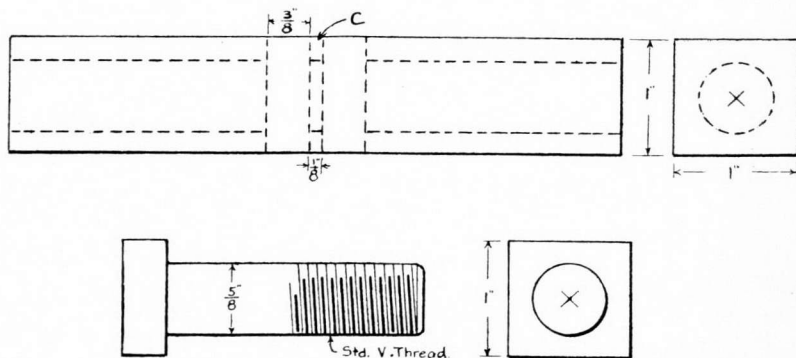


FIG. 10.—Milling-machine bolt

is to fit will take a bolt with a head $\frac{3}{8}$ inch thick (shown at fig. 11). The lip of slot $\frac{1}{16}$ inch, the base of the dividing head 1 inch, the washer $\frac{3}{8}$ inch, the faced nut $\frac{9}{16}$ inch. Our stock must be $\frac{3}{8}$ inch plus $\frac{1}{16}$ inch plus 1 inch plus $\frac{3}{8}$ inch plus $\frac{9}{16}$ inch equals $2\frac{3}{4}$ inches for one bolt. In making the pair we will allow $\frac{3}{8}$ inch on each end for finish and $\frac{1}{8}$ inch for cutting

in two with the parting tool. The required stock for the two bolts will be:

$\frac{3}{8}$ inch plus $2\frac{3}{4}$ inches plus $\frac{1}{8}$ inch plus $2\frac{3}{4}$ inches plus $\frac{3}{8}$ inch equals $5\frac{5}{8}$ inches.

(Bolts for other purposes may be substituted by the instructor.)

2. *Centering.*—We are to use 1-inch square stock. The centering must be accurate in order that the body of the bolts may be in the center of the heads. The center can be found easily by drawing the diagonals as in Figure 10. Punch, drill, and countersink, as in previous lesson.

3. *Face the ends.*—Face the ends to length as in lesson 2.

4. *Start the parting cut.*—The parting tool is equidistant from the ends with the cutting edge on a level with the center. One form of parting tool is shown in Figure 12.

This tool must be fed into the work very slowly by hand and kept well lubricated with lard oil or a good cutting compound. Care must be taken at all times while using this tool, as it is very apt to catch and bind in the work. Never try to cut the work entirely in two with this tool. After setting the tool, cut down to about $\frac{1}{16}$ -inch diameter at C, Figure 10.

5. *Using the round-nosed tool.*—Take the corners off of the first bolt, using the round-nosed tool, then reverse the work on centers and finish the second bolt, leaving stock for the $\frac{3}{8}$ -inch heads.

6. *Finish the body of each bolt.*—Finish the body of each bolt to size and square out the angles under the heads as in facing the shoulder bolt in the previous exercise.

7. *Finish the flats of the heads.*—Finish the flats of the heads with a hand file. Do not cut in two until the threads are cut. This will come later.

Questions

How do you tell whether a lathe is turning parallel?

If it is not turning parallel, what can be done to make it turn parallel?

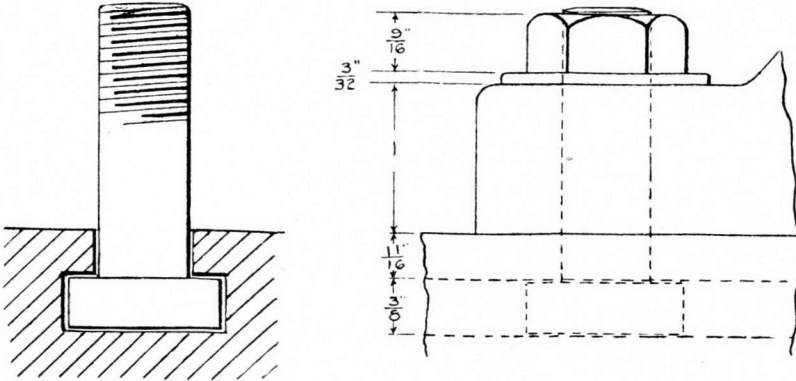


FIG. 11

(Read I. C. S. Lathe Work, sec. 17, pars. 52, 53, 54, 55, 56, and sec. 18, par. 5.)

Have some assorted steel balls. Set the calipers by the steel scale and test by the balls:

How closely can the calipers be set by the scale?

Why do you not cut the bolts in two with the parting tool?

How are the bolts to be cut in two?

Why turn only the corners of the first bolt before finishing the other end?

Lesson V.—Center punch

Read: "How to Run a Lathe," p. 34; Starrett Book, pp. 89–91.

Stock: $\frac{5}{8}$ -inch tool steel $5\frac{5}{8}$ inches long.

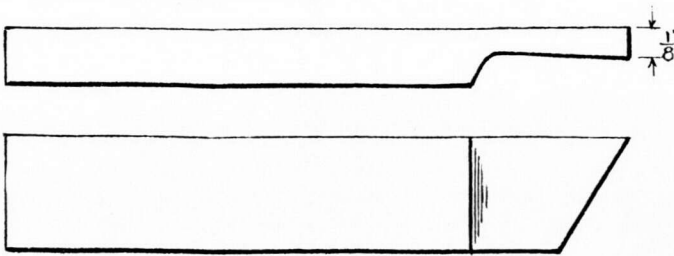


FIG. 12.—Parting tool

1. *Center and turn* to the required size for the full length. (*Caution:* Do not have the center deeper than necessary.) The stock must be centered very accurately, as there is only $\frac{1}{32}$ inch to be turned off. As the centers are both to be cut off, it will not be necessary to face the ends.

2. *Knurl.*—The knurling is done with a knurling tool. This tool has one or more steel rolls or knurls which have special teeth or designs cut on their faces. The tool is held in the tool post of the lathe. The piece to be knurled is driven slowly in the lathe while the knurling tool is fed against the work till the knurls make their imprint on the work. It is usual to feed

the knurl across the piece with the longitudinal feed. Several passes over the work may be necessary to cut the knurling as deep as desired. Knurl the piece a little farther than is required at each end.

3. *Turn the knurled part to the required length.*—B, Figure 13, shows the ends turned to the finished size leaving the knurled part.

4. *Turn the tapered end* by use of both feeds at once. (See I. C. S. Lathe Work, sec. 18, par. 19.) Set the lathe so the carriage feeds toward the tailstock when the feed is thrown in. Run the carriage away from the tailstock about half the length of the taper. Turn the cross-feed screw till the tool just touches the work. Start the lathe, throw in the feed, and as the tool travels toward the tailstock, feed it in slowly but evenly by hand with the cross-slide screw. After a little practice a fairly accurate taper can be cut in this way. This is good practice where the taper does not have to fit a socket, particularly if only a few pieces are to be turned. Other methods of turning tapers will be taken up later.

C, Figure 13, shows the punch finished except cutting off the centers.

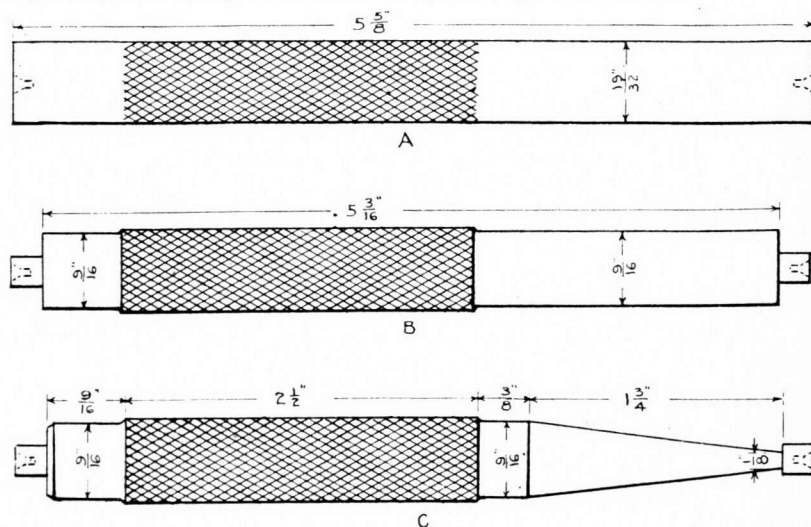


FIG. 13.—Center punch, stock $\frac{5}{8}$ -inch tool steel

Questions

1. We always cut toward the live center where possible. Why?
2. What is the object of knurling?
3. Will knurling increase the diameter of the piece?
4. Why do we cut toward the tailstock in turning the taper as above?

Rehabilitation monograph. Joint Series No. 16.

Unit Course—Machine Shop Practice II—Cutting V Threads Between Centers

ELEMENTARY THREAD CUTTING

February, 1919—Trial edition

PART I. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENTS

The student should have had Unit I on straight turning or its equivalent. Many persons will be found with experience in a machine shop who want special instruction in thread cutting to supplement their general training on the lathe.

2. ADVANTAGE TO BE DERIVED BY THE STUDENT

Thread cutting is a very general requirement for a lathe operator. One who has learned to produce good standard V threads has greatly increased his value, and his services are much more in demand than without this ability. Skill in thread cutting often opens the door also to a chance of getting advanced work.

3. APPROXIMATE TIME REQUIRED

This course is intended to cover 30 hours of study and practice by the pupil.

4. EQUIPMENT NECESSARY

Same as for Unit I on straight turning.

5. STANDARDS FOR RATING STUDENTS

In addition to the standards proposed for Unit Course I on straight turning, the student should become able to calculate the gearing for standard or special threads based on the inch measurement, to cut good smooth V threads, and make good fits in tapped holes or nuts. This work should also increase his ability to caliper and work to size on a lathe.

6. OUTLINE OF LESSONS

Lesson 1.—Threading the shoulder bolts made in Unit I.

Lesson 2.—Threading the milling-machine bolts made in Unit I.

Lesson 3.—Miscellaneous practice.

Lesson 4.—Kinds of threads and their standards (study).

7. SUGGESTIONS FOR INSTRUCTORS

See General Suggestions in Instructors' Manual for Unit I. For the work of Unit II the following points should be emphasized:

- (1) Familiarity with the lathe.
- (2) Grinding and setting the tool.
- (3) Figuring change gears for any standard lathe.
- (4) Cutting smooth threads.
- (5) Fit.
- (6) Methods of "catching" the thread to avoid reversing the lathe.
- (7) Use of lubricant.

8. REFERENCES

Same as in Unit I.

PART. 2. STUDENT'S INSTRUCTION SHEETS

LESSON I

1. Read I. C. S. Lathe Work, section 19, pages 1-62. The Starrett Book, pages 77-85. Smith: Advanced Machine Work, pages 318-356. Note the way calipers may be ground to caliper the root diameter of threads, Starrett Book, page 85. Be sure you understand how to guard against throwing two feeds in action at one time.

2. Thread the shoulder bolt made in Unit I. This is a nine-sixteenths-inch bolt and is to have a standard V thread.

The standard for nine-sixteenths-inch bolts is 12 threads per inch. (The student should at this point familiarize himself with the different kinds of threads and their standards. References: I. C. S., section 19, page 9; Starrett Book, page 78.)

If the lathe is of the change-gear type, the proper gears must be selected in accordance with the index plate on the headstock of the lathe. See that the gears mesh properly and that the carriage moves in the right direction to cut a right-hand thread.

At the top of this index plate will be found the words "Thread," "Stud," and "Screw," each heading a column of figures.

Thread refers to the number of threads per inch which the operator may wish to cut.

Stud means the small shaft which projects through the headstock of the lathe on which one of the change gears is mounted. The stud is driven by the gear on the spindle, through the idler, or reversing gears.

Screw means the lead screw which drives the carriage. The other change gear goes on the end of this screw.

Under each of these words will be found a column of figures, as shown:

Thread	Stud	Screw
2	72	24
3	72	36
4	72	48
12	24	48

Suppose that we are required to cut 12 threads per inch. In the column under "Thread" we find 12, the number of threads we wish to cut. Opposite 12 we find under the word "Stud" the figure 24, which means that we must have a 24-tooth gear on the stud. Looking under "Screw" we find that the figure 48 is opposite 12 and 24, which means that we must have a 48-tooth gear on the screw.

Some workmen depend entirely on this index plate, but as a man who can think things out is more valuable than one who has to be told, we will take up the methods for making simple gear calculations.

Suppose we wish to select change gears to cut 12 threads per inch without depending on the index plate. From the fact that 12 threads must be cut to each inch, we know that the spindle and the work must revolve exactly 12 times while the tool travels 1 inch.

The tool and carriage are moved by the lead screw. If the lead screw has 6 threads per inch it must turn 6 times to move the carriage and tool 1 inch. That is, the screw must turn 6 times while the work turns 12 times. This is a ratio of 6 to 12, or, as it is often written, $\frac{6}{12}$.

If we use gears of this ratio, we will get the thread desired, but there are no gears of 6 or 12 teeth in the set. If we multiply each of these numbers (6 and 12) by a common multiplier, the ratio or relation between the two numbers remains the same— $\frac{6}{12} \times \frac{4}{4} = \frac{24}{48}$; 24 and 48 have the same ratio to each other as 6 and 12. We probably have a 24 and a 48 tooth gear in the set. 30 and 60, 36 and 72, or 42 and 84 would do as well.

Now the only thing to decide is which gear goes on the stud, and which on the lead screw. The ratio is expressed as:

$$\frac{\text{Number of threads on the lead screw}}{\text{Number of threads to be cut}} = \frac{6}{12}$$

This is for lathes where the stud is geared to turn at the same speed as the spindle or work.

Always place the number of threads of the lead screw above the number of threads to be cut, $\frac{6}{12}$. Now, if we use our common multiplier 4, as above, we get the equivalent ratio, $\frac{24}{48}$. Put 24 on the stud and 48 on the screw. The 24 is above 48. The stud is above the screw.

Another way to decide which gear goes on the stud is this: If the thread being cut is *finer* than the lead screw, the *smaller* gear goes on the stud. If *coarser* than the lead screw, the *larger* gear goes on the stud.

Many lathes are so made that the stud turns at a different (usually at less) speed than the spindle. On the gear table of all lathes there will be found some one thread that can be cut with gears of the same number of teeth. For example, 44 on the stud and 44 on the screw may cut 8 threads.

Let us call this number of threads, whatever it may be, the "effective pitch" of the screw. Some call it the "lathe screw constant." If we use this "effective pitch" in calculating change gears it will make no difference what the stud-spindle ratio actually is—we can use the method described above.

In our first problem 12 threads were required, and six was the number of threads on the lead screw. If we find from the index plate that 44 and 44 cut 8 threads, we will use 8 as the effective pitch of the lead screw, and our problem becomes:

$$\frac{8 \times 4 = 32 = \text{gear on stud.}}{12 \times 4 = 48 = \text{gear on screw.}}$$

If the lathe is the quick-change gear type, the student will consult the table on the lathe for the proper position of the levers.

Thread-cutting tools are made in a number of different styles. Two of the most common thread tools are shown in Figure 1.

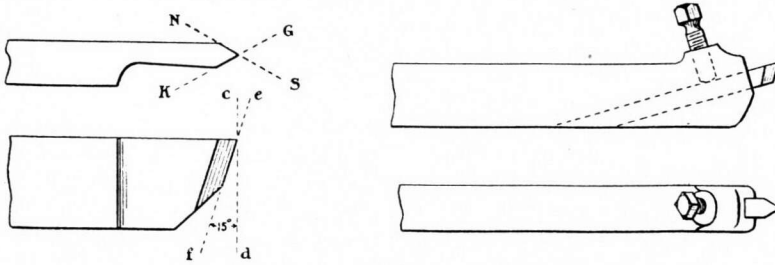


FIG. 1

The cutting edge of the tool is ground to a 60 degree angle for cutting a V thread.

The point of the thread tool must be set exactly the height of the line of centers. The tool must be clamped firmly in the tool post so that the cutting edges a-b and c-d (Fig. 2) make equal angles with the axis of the work.

To cut the threads on the nine-sixteenths-inch shoulder bolt, proceed as follows:

1. Select the gears and place them on the lathe in the proper place, as described above. Have the gears mesh properly, not too tightly. Fasten the intermediate gear bracket so that it will not drop.

2. Grind the thread tool to 60° by the center gauge and set it in the tool post according to directions given in Smith's Advanced Machine Work, pages 323-324. The tool must be

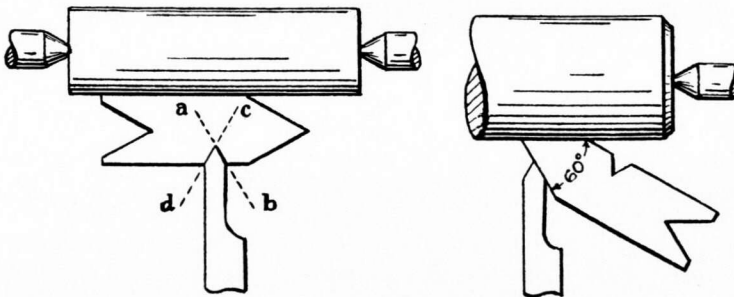


FIG. 2

clamped firmly in the tool post so that the cutting edges fit the center gauge when tested, as in Figure 2.

3. Run the carriage back toward the tailstock until the point of the tool is near the end of the work.

4. Feed the tool in by means of the cross-feed screw till the point just touches the work; then run the carriage toward the tailstock until the tool is free from the work.

5. Feed the tool in about 0.002 of an inch. Close the split nut. Turn the lathe over by hand to make sure the tool will feed toward the headstock.

6. Start the lathe by power and let the tool scratch the bolt lightly for a little more than 1 inch. Count the threads as marked to be sure that there are the required number per inch. This will tell whether the lathe is geared properly.

7. After taking the first cut the tool must be withdrawn. Without loosening the split nut, reverse the machine and allow the tool to travel back to the end of the piece of work, where it is adjusted for the second cut. This method is usually employed in cutting short threads with a belt-driven machine.

8. Feed the tool in about 0.005 deeper than before and take another cut. Use lard oil, a good thread-cutting oil, or a cutting compound on the work and tool, when cutting wrought iron or steel. Always turn the tool out of the work at the end of the cut while the work is revolving. If the lathe is stopped and the tool withdrawn while the pressure of the cut is still on the tool, the point of the tool is very apt to be broken.

In cutting threads the operator usually stands with his right hand on the shifter handle and his left on the cross-feed screw handle. The motions become almost automatic with a little practice. Back out the tool with the left hand and then reverse the lathe with the right hand. The lathe speed should be slow—about half the usual speed used for turning—until the motions are learned.

The finished thread should continue the required depth up to its last quarter of a turn. Then the tool is gradually turned out until it clears the work. These cutting operations should be repeated, advancing the tool a few thousandths of an inch for each cut, gradually decreasing the depth of the cut as the thread nears completion.

9. Test for size by standard nut or calipers.

Resetting the threading tool.—If it is necessary to remove the tool from the tool post for any reason before the thread has been completed, the tool is reset in the lathe as per the previous instruction, no notice being taken of the relation of the tool to the part of the thread already cut. The tool is set to the proper height. It is squared up with a center gauge. The half nut is closed and the lathe is started, to take up all lost motion in the machine. The machine is stopped and the tool tried for alignment. If it is found that the point of the tool does not exactly enter the V formed by the previous cut, the idler gears are very carefully thrown to their neutral position. This disconnects the spindle from the lead screw. Revolve the work in the forward direction until the bottom of the thread being cut is exactly opposite the point of the tool. If by chance the work is revolved too far, do not turn the lathe backward, but continue the revolution until the thread comes exactly opposite the point of the tool. Reengage the idler gears, start the lathe, and see if the tool exactly follows the thread. If it does not, the lathe must be stopped and the operation repeated. Successive cuts are taken until the thread will fit a standard gauge. If a standard gauge is not available, or if the screw is to fit an inaccessible nut or tapped hole, it is often necessary to depend on calipering the root diameter of the thread. This diameter may be obtained by calipering the tap that produced the thread, taken from a table of screw threads, or found by subtracting double the depth of the thread from the diameter of the work. This double depth is usually found stamped on the center gauge.

In the making of this shoulder bolt the principles, operation, and tools used have already been fully described. These principles will be employed in all work between the centers of the lathe.

Questions

1. Explain the index plate and its use.
2. What is meant by the term *change gear* lathe?
3. What is meant by the term *quick change gear* lathe?
4. Name three things to look out for in setting a threading tool.
5. How would you cut a left-hand thread on a lathe?

LESSON 2. THREADING THE MILLING-MACHINE BOLTS, FROM MACHINE-SHOP PRACTICE I

1. Calculation of gearing same as for lesson 1, but for 11 threads per inch.
2. Grind and set tool as before.
3. Mount the bolts in the lathe and cut the thread on the first bolt, as in lesson 1.
4. Test with a standard nut.

5. Secure two tapped nuts and jam them together on the thread of the first bolt. Place a dog on these nuts and mount the work in the lathe for cutting the threads on the second bolt. (The nuts are a protection for the first threads while cutting the threads on the second bolt.)

6. Saw the bolts in two and file off the rough projections. Avoid rounding the top of the heads with the file.

Questions

1. If the pitch of the lead screw is 6, what gears will be required to cut 13 threads per inch? (Stud—spindle ratio=1 to 1.)

2. If 36 gear on stud and 36 gear on screw will cut 8 threads, what gears will be required to cut 16 threads?

3. In calculating change gears, how can you tell which gear goes on the stud and which on the screw?

LESSON 3. KINDS OF THREADS AND THEIR STANDARDS

References

1. I. C. S. Lathe Work, section 19, pages 1 to 62; also American Machinists' Handbook, pages 4 to 77.

2. I. C. S. Lathe Work, section 19, pages 37 and 38; also Smith's Advanced Machine Work, page 532.

3. I. C. S. Lathe Work, section 19, pages 39 to 43; also Smith's Advanced Machine Work, pages 506 to 510.

4. I. C. S. Lathe Work, section 19, pages 24 to 32; also Smith's Advanced Machine Work, pages 333 to 335.

5. I. C. S. Lathe Work, section 19, pages 48 to 49; also Smith's Advanced Machine Work, page 336.

Definition.—A machine screw thread is the ridge left on a cylindrical piece by cutting a helical groove around the piece with a tool which at each turn of the work advances regularly in the direction of the axis through a distance equal to the lead of the screw.

When a single groove is cut it is known as a single thread. If two or more grooves are cut they are known as a multiple thread. (See reference No. 1.)

Kinds.—There are a great many kinds of threads, and each thread has a standard of its own. The threads that are the most commonly used are the V, United States standard, square, and acme.

The acme is a modified form of the V and the square threads, and is used most frequently in lead screws of lathes, and as a thread on worms.

Besides these there are the British standard and buttress threads.

Standard.—By the term standard is meant the number of threads per inch of a given diameter for the kind of thread being used. The standard V, or United States standard thread for a $\frac{5}{8}$ -inch bolt, is 11 to the inch. This means that we can ask anywhere in this country for a $\frac{5}{8}$ -inch bolt, and find that it has 11 threads to the inch, because 11 has been adopted as the standard for $\frac{5}{8}$ -inch diameter.

The terms "V," "United States Standard," "Acme," "Square," etc., refer to the *shape* of the thread. Each shape has a standard number of threads of its own.

The cutting of a V thread and gear calculation have already been explained. If the student has thoroughly understood the cutting of this thread he will have no difficulty in cutting any of the other threads. The only difference is that he will be using a different shaped tool; and that on some of the threads where he is using a broad-nosed tool (such as square or acme), the depth of the cut must be more carefully adjusted.

Multiple threads are cut the same as single threads. The only difference is in the proper setting for the separate threads. (See reference No. 2 above.)

In cutting threads on a taper, as in making a gas-pipe tap, the tool is *always* set at right angles to the line of centers, and is *never* set perpendicular to the face of the taper.

The principles in thread cutting are always the same, no matter what kind of thread is being cut, or whether it is a straight, taper, or internal thread.

Inside thread cutting.—When cutting inside threads the work is usually held in a chuck. The piece is faced off and bored out to the root diameter of the thread it is to fit. The tool used for internal threading is similar to a boring tool, the only difference being that the cutting edge is of the same shape as the desired thread.

The lathe is geared in the usual manner. The tool is set to the height of the center of the piece, and squared up to the inside face of the hole with a center gauge. Proceed as in previous instruction. (See reference No. 3.)

For Gear Calculation, see reference No. 4.

For use of Thread Indicator, see reference No. 5.

There are several different ways of producing internal threads. They may be cut on an engine lathe, as described. They may be cut by hand—"Hand tapping." They may be cut in a special machine—"Tapping machine" or "Nut tapper."

On fairly large work, such as face plates, the threads are usually cut almost to size on a lathe, and brought to the size with a tap. This tap is known as a sizing tap.

Additional practice should be arranged if time permits. Examples are to be selected by the instructor and given as above.

Practice cutting threads of various sizes. Aim at smooth threads and a good fit. Keep the thread tool sharp.

Questions

1. Name five different kinds of threads.
2. What does the term *standard* mean?
3. In cutting threads on a taper, how should the tool be set?
4. Name four ways of producing internal threads.
5. What is the angle of a V thread? An acme thread?
6. How is the threading tool squared up with the work?
7. What is the function of the split nut?
8. What precautions should be taken in resetting threading tools?
9. How can you tell when a thread is finished?

Rehabilitation monograph. Joint Series No. 17.

Unit Course—Machine Shop Practice III

CHUCKS AND CHUCK WORK

January, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF THE STUDENT

In order to do the work of this course the student should have had experience in operating the engine lathe equivalent to the work covered in Machine Shop Practice I, "Straight Turning Between Centers."

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

This unit is intended to teach the use of the more common chucks and give practice in mounting work correctly. If a man can do ordinary straight turning, thread cutting, and chuck work he is able to handle a large part of the work that is called for in a machine shop.

3. APPROXIMATE TIME REQUIRED

Thirty hours for an average man.

4. EQUIPMENT NECESSARY

The list of equipment specified for Unit Courses 1 and 2 will be needed for this course, and in addition a four-jaw independent chuck.

5. STANDARDS FOR RATING

(See "Measuring, Rating, and Recording Student's Work," in Teacher's Manual for Unit Course, Machine Shop Practice I.)

6. OUTLINE OF LESSONS

Lesson 1.—Classification of chucks, description and use.

Lesson 2.—Chucking and finishing of a cast-iron washer.

Lesson 3.—Chucking and finishing of a flywheel.

The projects suggested above are not necessarily mandatory. The teacher may use any other projects that involve the main principles included in the lessons.

7. SPECIAL SUGGESTIONS

(See "Suggestions to Instructors" in Teacher's Manual for Unit Course, Machine Shop Practice I.)

Caution the student against mutilating the chuck.

Have the chuck thread and spindle thread clean before screwing the chuck onto the spindle. The cleaner (fig. 1) is a convenience.

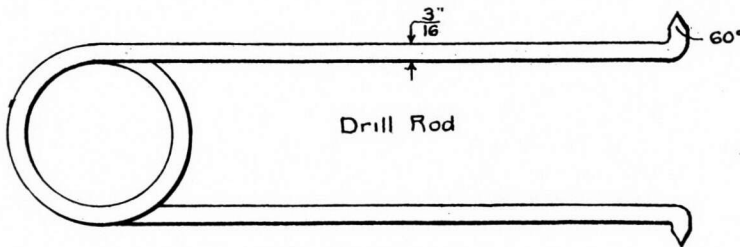


FIG. 1.—Chuck thread cleaner

Caution against running the chuck on at high speed.

Emphasize the need of properly centering pieces that are to revolve at high speed, so as to secure good "balance."

In a talk with the students, explain the difference between "standing" and "running" balance.

Several washers should be made by each student.

8. REFERENCES

Same as in Unit II.

Encourage reading mechanical papers.

PART 2

LESSON I.—CLASSIFICATION OF CHUCKS

References:

I. C. S., "Lathe Work."

Section 15, pages 29 to 38.

"Advanced Machine Work," Robert H. Smith.

Pages 401 to 490 and 440 to 510.

Chucks are classified as drill, independent, universal, and combination. There are also several kinds of special chucks.

Many pieces are so shaped that they can not be held between the centers of the lathe and so must be held in some other manner. Chucks are designed to take care of a large part of this class of work.

Questions

1. Describe a combination chuck.
2. What is meant by the term "reversible jaw"?
3. Describe two types of reversible jaws used in chucks.
4. Describe an independent chuck.
5. Describe a universal chuck.
6. What is meant by the face plate of a chuck?
7. What is meant by the term "drill chuck"?

LESSON II.—A CAST-IRON WASHER TURNED IN A CHUCK

It will be readily seen that this piece could not be turned between the centers of a lathe. The different steps in chucking will be as follows:

1. Select either a three or four jaw independent chuck. (This work may be done in any common form of engine lathe chuck of sufficient capacity. The independent chuck is most

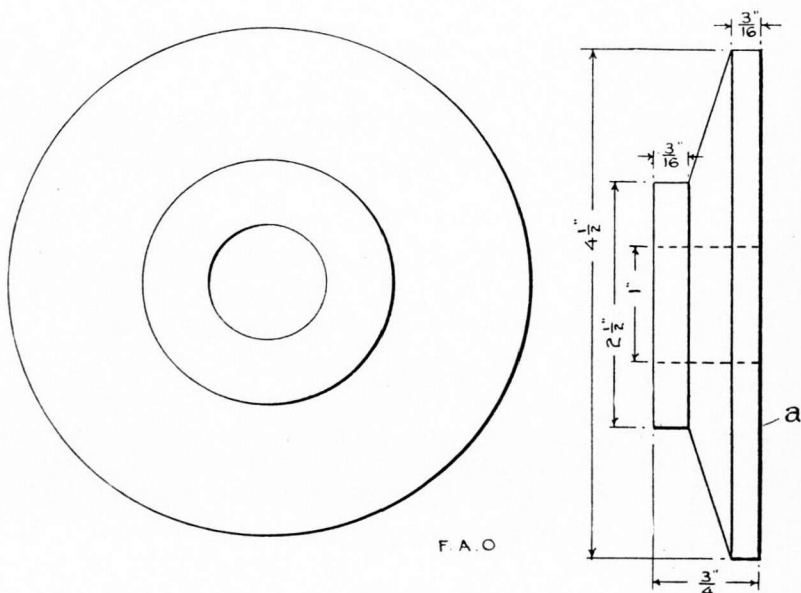


FIG. 2

universally used. It is a much stronger chuck than the universal, and is always used where accuracy is required.) The universal chuck is used for the most part on duplicate work, and where the part to be gripped in the chuck has been previously machined. The piece referred to in the figure is to be machined all over. The two sides must be parallel with each other.

2. Chuck this piece with the face (a) away from the chuck.

3. Adjust the piece until it runs true. This must be done so that the edge and face will both run true. Any piece that requires facing must project far enough beyond the jaws of the chuck to allow the tool to pass, while taking the cut, without hitting the jaws.

4. *Caution.*—Care should be exercised to see that the piece runs true and that it is clamped tightly enough to resist the force of the cut. In light work, the piece must not be sprung out of shape by the clamping.

5. Use the round nose tool for facing. Set the tool to the center of the work, and at right angles to it.

6. Run the tool into the work to the depth of the cut.

7. Lock the carriage with the locking screw, or hold the carriage wheel, so that the force of the cut will not push the tool and carriage away from the work.

8. Feed the tool outward across the work, and produce a perfectly flat face. This is known as *radial facing*. Radial facing should always be done before drilling and boring.

9. The hole is next bored out to within $\frac{1}{16}$ inch of the size. (Description of tools used for this kind of work will be found in I. C. S., "Lathe Work," sec. 16, pp. 21-24, and "Advanced Machine Work," by Robert H. Smith, pp. 504-510.)

10. Ream to size. (The most common form of chucking reamer is shown in I. C. S., "Lathe Work," sec. 16, p. 35, fig. 56. Also read p. 36.)

Reaming is done to produce smooth holes, of exact size, and with parallel sides. The less stock that is left for the reamer to remove the more true to size the hole will be.

11. Press the work on a hardened steel mandrel. (Mandrels are described in I. C. S., "Lathe Work," sec. 15, pp. 41-50, and "Advanced Machine Work," by R. H. Smith, pp. 420-423 and 1202-1211.)

12. Mount the mandrel between the lathe centers in the usual way. Great care must be exercised in using a hardened steel mandrel between centers that it is not put in too tightly.

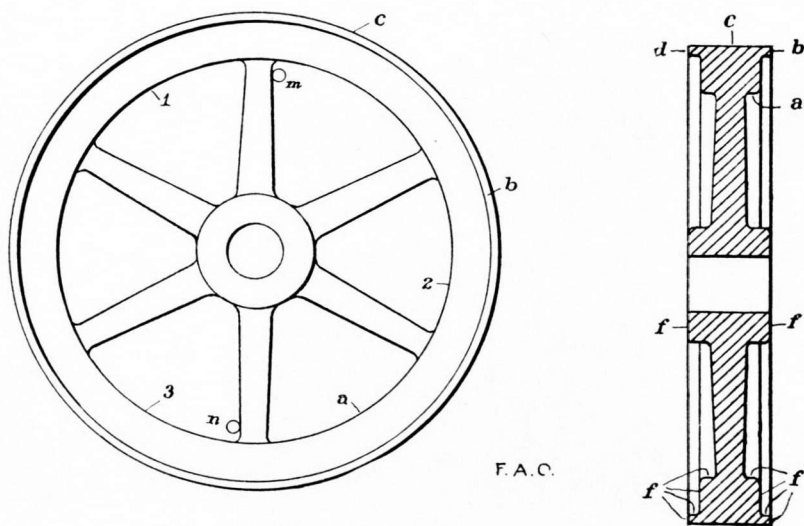


FIG. 3.—Flywheel

The mandrel and centers are both tool steel and hardened. If too much pressure is put on the center it will generate heat, thus causing the mandrel to expand (get longer) and the center will "gall" and be burned off.

The balance of the work will be performed as in plain center turning. The slant of the collar may be turned with a compound rest. Set the compound rest to $17\frac{1}{2}^\circ$. (For compound rest see "Advanced Machine Shop Work," by R. H. Smith, pp. 1131 and 1132; also I. C. S., "Lathe Work," sec. 18, pp. 9-11.)

Questions

1. What precaution should be taken in putting a hardened steel mandrel between the centers of a lathe? Why?
2. Why should radial facing always be done before boring and reaming?
3. Name three things to guard against in chucking a piece that is to be faced.
4. What precaution should be taken in chucking a thin piece? A heavy one?
5. What kind of chuck is best suited to general work? Why?
6. What is meant by the term "compound rest"? To what kind of work is it best suited?

LESSON III.—CHUCK AND FINISH A FLYWHEEL

1. The flywheel must be machined all over except the spokes and rim between the spokes.
 2. The machining operations are practically the same as those already explained, except that the piece is larger, heavier, and requires greater care.

3. In chucking a piece of work of this kind it should always be trued up by the inside of the rim as at (a) in the figure. This insures the approximate "balance" of the wheel.

The chuck jaws are reversed so as to chuck the wheel by contact with the inside of the rim at 1, 2, and 3.

This method of chucking makes the work more rigid, reduces "chattering" to a minimum, and permits of a great amount of work being done on the piece before rechucking or putting on a mandrel.

4. A flywheel chucked in this way should have the hub faced, the center hole bored and reamed, and the parts *a*, *b*, *c*, and *d* machined, before being removed from the chuck.

5. It will require a special attachment to face "*d*."

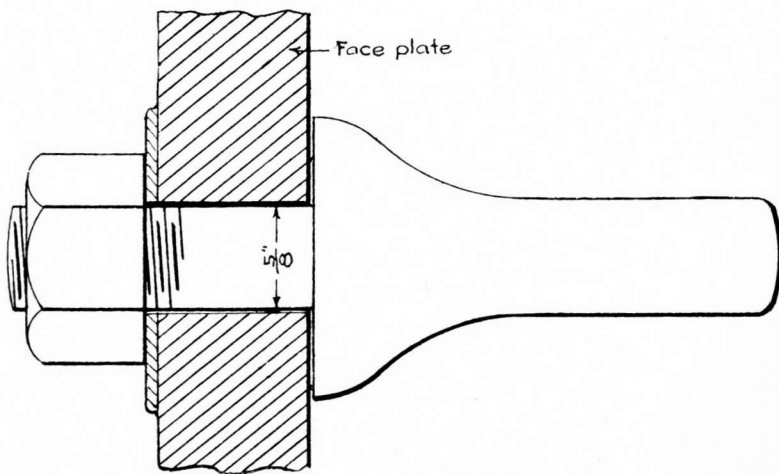


FIG. 4.—Faceplate driver

6. It will be necessary to put the piece on a mandrel to face the end of the hub and the part that was next to the chuck.

7. To drive the work while it is on the mandrel, it is essential that the driving force be applied as far out on the wheel as possible, and from opposite points at *m*, *n*.

8. The driving is usually accomplished by bolting pins or drivers through the faceplate so that they will catch the spokes on opposite sides of the wheel. One form of such a driver is shown in Figure 4.

Questions

1. What is meant by the term "balance"?
2. What is "chattering"? How would you overcome it?
3. Why is it better to chuck a flywheel under the rim?
4. What is the objection to chucking this piece on the face "*c*"?
5. How should you true up a piece of this kind?

Rehabilitation monograph. Joint Series No. 18.

Unit Course—Machine Shop Practice IV—Taper Turning

TAPER TURNING

January, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF THE STUDENT

It is assumed that the student, before taking the unit course on taper turning, has previously taken the unit course on straight turning or has had an equivalent experience.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

The use of tapers is so common in machine shop practice that the good machinist must be able to make these tapers of perfect fit. This course is therefore designed to give the student the necessary instruction on this important topic.

3. LENGTH OF THE COURSE

The average student should complete the work herein outlined in 30 hours of study, instruction, and practice.

4. EQUIPMENT

The same tools are used as in the unit on straight turning. It is also desirable to have in the school shop at least one lathe equipped with a taper-turning attachment.

5. STANDARDS FOR MEASURING AND RECORDING PROFICIENCY OF STUDENTS

See "Measuring, Rating, and Recording Student's Work" in Teacher's Manual for Unit Course, Machine Shop Practice I.

6. OUTLINE OF LESSONS

- | | |
|------------------|------------------|
| 1. Center punch. | 3. Nut mandrel. |
| 2. Lathe center. | 4. Selected job. |

7. SUGGESTIONS FOR CONDUCTING THE WORK

See "Suggestions to Instructors" in Teacher's Manual for Unit Course Machine Shop Practice I.

- (1) Calculations for setting lathe to be made by student.
- (2) Difference between taper per foot and taper given by difference in diameter.
- (3) The taper attachment is always set by taper per foot.
- (4) In setting over the tail stock, the taper must be reduced to equivalent taper for the length of the piece.
- (5) Accurate setting for taper is a matter of cut and try.
- (6) The point of the tool must be level with the lathe center.
- (7) When using the taper attachment the tool must be run well back beyond the end of the taper so as to take up all lost motion before beginning to cut.

8. REFERENCES

- I. C. S. Lathe Work. International Correspondence School, Scranton, Pa.
The Starrett Book. L. S. Starrett Co., Athol, Mass. Price, \$0.75.
Machinery Reference Books—Operation of the Lathe, Parts I and II. Industrial Press, New York. Price, \$0.25 each.
American Machinist Handbook. McGraw Hill Book Co., New York. Price, \$3.
Machinery Hand Book. Industrial Press, New York. Price, \$6.

Robert H. Smith, Advanced Machine Work. Industrial Education Book Co., Boston, Mass. Price, \$3.

A Hand Book for Apprenticed Machinists, Brown & Sharpe Manufacturing Co., Providence, R. I. Price, \$0.50.

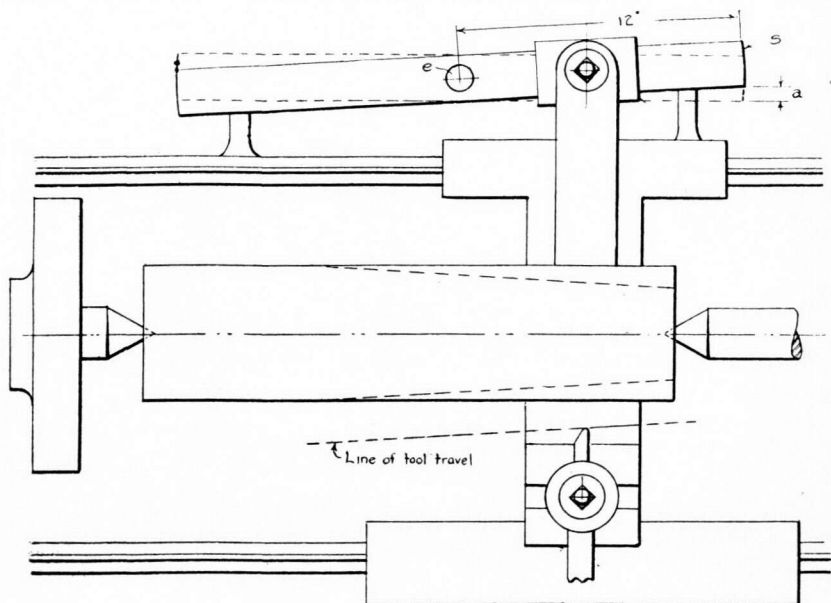
PART 2. STUDENT'S INSTRUCTION SHEETS

GENERAL DIRECTIONS

Read I. C. S. Lathe Work, section 18, pages 1-12; Smith, Advanced Machine Work, page 226.

When a taper is to be turned the line of travel of the tool must be parallel with the side of the taper.

In Figure 1 we obtain this by means of the taper attachment.



Tool travel parallel to the side of the taper.
a = Set-over of guide

FIG. 1.—Taper turning. Taper attachment

If a taper attachment is not available, the tailstock center is set over until the side of the work is parallel with the line of tool travel.

Lesson 1.—Center punch

As an illustration of the method of turning tapers, a center punch of the same dimensions as that in Unit I may be made. (It can be used as nail set, prick punch, or plain round punch by a slight modification of the shape of the point.)

For sketch and dimensions see Unit I.

1. The stock will be gotten out and centered as in Unit I.
2. A roughing cut is taken over the piece.
3. Taper is calculated.

Explanation: This is figured in taper per foot if a taper attachment is to be used. The graduations on the taper attachment indicate taper per foot. The taper to be given to the punch is $\frac{3}{16} - \frac{1}{8} = \frac{1}{16}$ inch in $1\frac{3}{4}$ inches. The taper in 1 inch is $\frac{1}{16} \text{ inch} \div 1\frac{3}{4} = \frac{1}{4}$ inch. The taper per foot is 12 times the taper per inch or $12 \times \frac{1}{4} \text{ inch} = 3$ inches. This means that the end of the guide of the taper attachment must be moved over $1\frac{1}{2}$ inches (a, fig. 1) to bring

the tool travel parallel to the taper. The graduations are made to read direct in inches per foot. Instead of reading $1\frac{1}{2}$ inches, as on a standard scale, they will read 3 inches per foot on the graduated end of the guide. The distance from the center of the pivot *e* to scale *s*, Figure 1, is usually 12 inches.

If this taper is beyond the limits of the taper attachment or if a taper attachment is not available the job must be done by setting over the tailstock center. The only difference between this method and the use of the taper attachment is that the actual amount of set-over of the center depends on the length of the work between centers. In the case of the punch the taper was found to be $\frac{1}{4}$ inch per inch of length. The taper in $5\frac{5}{8}$ inches is $5\frac{5}{8} \times \frac{1}{4}$ inch = $\frac{3}{8}$ inch. The center must be set over one-half of this amount or $\frac{3}{16}$ inch (a, fig. 2).

Caution.—In this case care must be taken that the tail of the dog is free in the faceplate slot at all parts of its revolution.

In turning duplicate tapers on several pieces of equal length by setting over the tailstock, the centers in all the pieces must be of the same depth or the same setting will not produce the same taper.

4. Set the tool exactly on level with the lathe center and proceed as in straight turning.

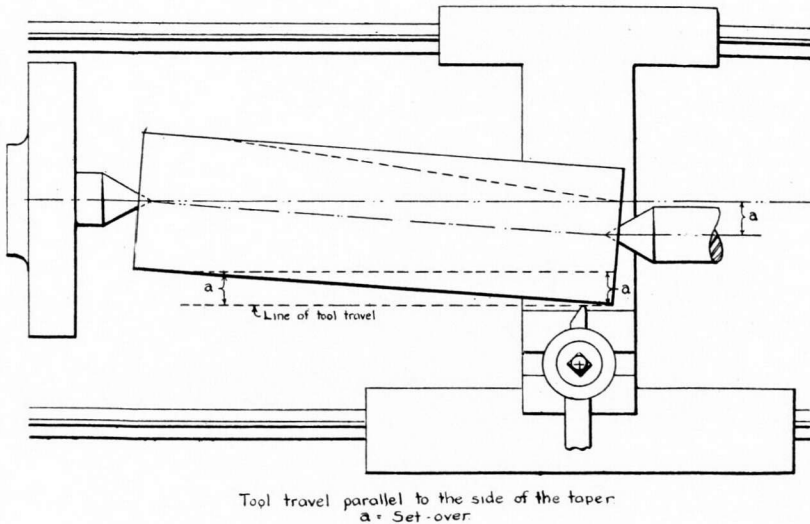


FIG. 2.—Taper turning

Questions

1. If two pieces of equal length are to have duplicate tapers, what will be the effect if one has centers drilled deeper than the other?
2. What will be the result of having the tool above the center line?
3. What if the tool is below the center?
4. How much will the centers have to set over on a piece 9 inches long to obtain $\frac{3}{4}$ -inch taper per foot?
5. What will be the taper, per foot, of a taper that is 4 inches long and calipers nine-sixteenths inch at one end and three-fourths inch at the other end of the taper?

Lesson 2.—Lathe center

Read I. C. S. Lathe Work, section 17, pages 11–13; I. C. S. Lathe Work, section 17, page 9; I. C. S. Lathe Work, section 18, pages 11–12.

Turn a lathe center from tool steel to fit the spindle of the lathe.

1. Center carefully.

(*Caution.*—Tool steel has a decarbonized surface and a skin tension. If more is taken from one side than the other, due to improper centering, the piece is almost sure to warp in hardening.)

2. Calculate the taper as in Lesson 1 and set the lathe accordingly.

3. Turn the taper and test in the spindle.

(*Caution.*—This testing must be done before the taper is too near the final size to allow for correction. The fit must be on the full length of the taper. Be sure that the tool is on a level with the centers.)

Turn to finished size.

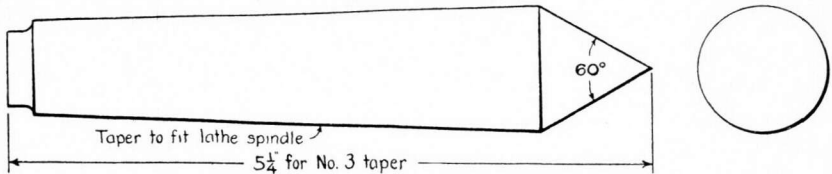


FIG. 3.—Lathe center

4. Place the center solidly in the spindle of the lathe.

(*Caution.*—Whenever a center or taper shank is placed in a lathe spindle or taper socket both must be clean. If the lathe has been used for chuck work there is always danger of chips and dirt in the hollow spindle.)

5. Turn the 60° point by setting the compound rest to the proper angle to give the line of tool travel parallel to the surface to be cut.

6. Test the center by the center gauge.

Read I. C. S. Lathe Work, section 15, pages 19–21.

Questions

1. Why is 60° selected for threads and centers?
2. How would you make a 60° gauge or template if you had no way of measuring 60°?
3. Through how many degrees do you turn the compound rest to cut the 60° point?

Why?

Read I. C. S. Lathe Work, section 18, pages 9–10, paragraphs 17 and 18.

Lesson 3.—Nut mandrel

The sizes given are for a Morse No. 3 taper and to fit a $\frac{5}{8}$ -inch nut. Stock, mild steel, $1\frac{1}{8}$ inches square, $5\frac{1}{2}$ inches long. Other sizes for standard nuts may be assigned so as to accumulate a full set for shop use.

1. Center and square the ends.

2. Cut down at A slightly below the taper.

3. Turn the taper to fit the lathe spindle. For sizes of taper see Machinery Hand Book, pages 1108–1110; American Machinists' Hand Book, pages 346–363; The Starrett Book,

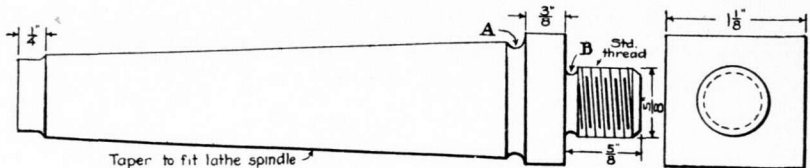


FIG. 4.—Nut mandrel

page 88; and in most small tool catalogues.

(*Caution.*—Use care in fitting so that there is no shake and a good bearing is assured the full length of the taper.)

4. Seat the mandrel in the live spindle of the lathe.

5. Turn the thread end to size, leaving the square head of proper thickness.

6. Face the head and turn B to a diameter equal to the root diameter of the thread to be cut. (See I. C. S. Lathe Work, section 19, page 6.)

(Explanation.—This groove is to avoid the incomplete thread next to the shoulder.)

7. Remove the mandrel from the lathe by means of a wrench and finish the head with a file.

8. Stamp the size on the side of the head with steel stencils.

NOTE.—The thread is to be cut in connection with the work of Unit Course No. 2, "Thread Cutting."

Questions

1. When do you use nut mandrels?
 2. How are the threads cut in standard nuts?
 3. Why maintain the standard number of threads per inch for each size?
 4. What is the difference between V threads and United States standard threads?
- I. C. S. Lathe Work, section 19, pages 5-14.

Lesson 4.—Selected job

A piece of work that involves taper turning, selected by the instructor.

The student should be put on his own resources to apply what he has learned in previous lessons.

Questions

1. What are the objections to setting over the tailstock center when turning short pieces with a great deal of taper? See I. C. S. Lathe Work, section 18, pages 7-12.
2. What precautions should be taken when using the taper attachment?

Rehabilitation monograph. Joint Series No. 19.

Unit course—Machine shop practice V

DRILL PRESS WORK

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF THE STUDENT

This unit may be taken without previous shop experience, by any one who is interested in mechanical work, and who can make intelligent use of English. An ability to handle common and decimal fractions is very desirable.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

Ability to use the drill press is one of the first requirements of the machine shop. This unit will give the man a start in general machine shop work.

3. APPROXIMATE TIME REQUIRED

Twenty hours is required for an average man. More time is advisable if possible.

4. EQUIPMENT NECESSARY

A standard drill press, 20 or 24 inches, with back gear, hand and power feeds.

Taper shank drills $\frac{1}{2}$ to $1\frac{1}{4}$ by $\frac{1}{16}$ of an inch.

Drill sockets No. 3 to No. 2 and No. 3 to No. 1.

Mounted drill chuck to hold from 0 to $\frac{1}{2}$ inch drills.

Drill-press vise.

Bolts, clamps, parallel strips, V blocks, and angle plates.
 Dividers, 5 inches.
 Outside and inside calipers.
 Center punch and prick punch.
 Hammer, 1 pound.
 Monkey wrench, 10 inches.
 Cold chisels: Flat, cape, and round nose.
 Machinist's hand taps and tap wrench.

5. STANDARDS FOR RATING

See "Measuring, Rating, and Recording Student's Work" in Teacher's Manual for Unit Course, Machine-Shop Practice I.

Ability to lay out and drill holes within reasonable limits of accuracy in reasonable time should be considered as a standard for this course. The more experience and the more mechanical ability, the closer the limits. For the first work $\frac{1}{64}$ inch may be as close as can be expected. Some may not be able to reach this limit in the time allowed.

6. OUTLINE OF LESSONS

1. Drills and drill presses.
2. Drilling two $\frac{3}{8}$ -inch holes 1 inch apart.
3. Drilling six $\frac{3}{4}$ -inch holes equidistant in a circle.
4. Side-hill drilling.
5. Tapping by hand, through hole and blind hole.

7. SUGGESTIONS TO INSTRUCTOR

See "Suggestions to Instructors" in Teacher's Manual for Unit Course, Machine Shop Practice I. The following are special points for emphasis in connection with this course:

1. Ability to lay off and drill accurate holes where they are called for in the drawing or sample.
2. "Drawing the drill." This requires practice and judgment.
3. Speed of the drill. This can be gotten from the various reference books till the student becomes experienced in choosing the proper speed for different sizes of drill in different metals.
4. Practice in side-hill drilling and drilling into blow holes is important. This requires careful use of the cold chisel. An end mill or sweep cutter is often used to level a place to start the drill.
5. Cast iron and brass do not require a lubricant. A lubricant, lard oil, or cutting compound, should be used for steel and wrought iron.
6. Caution to run slower when drilling thin plate, particularly if placed on a piece of wood, as is often done to protect the drill-press table.
7. A flat drill or a twist drill with the edge ground so as to remove the "rake" is desirable for brass or thin plate.
8. Caution the student not to try to hold a piece by hand that is liable to catch and swing on the table. Such accidents are especially liable with pieces of flat plate and often result in painful injury to the hands.
9. In using taps, particularly in blind holes, use care not to break the tap. Cultivate the "feel" which indicates the strain on the tap.
10. Jig drilling is very simple and is not touched upon here. The man who can do a good job of drilling without the jig will have no trouble with this fixture.

8. REFERENCES

I. C. S., "Drilling," section 13, 14, International Text Book Co. (Detailed instructions for apprentices and others.)

Starrett Book, L. S. Starrett Co., Providence, R. I. Price 75 cents. (Good practical directions for machine-shop work of various kinds. Directions for calipering, drill speeds, etc.)

Machinery Hand Book, Industrial Press, New York. Price \$6. (Standard mechanics' reference book.)

American Machinist's Hand Book, McGraw-Hill Book Co., New York. Price \$3. (Standard machinists' reference book.)

Hand Book for Apprenticed Machinists, Brown & Sharpe Manufacturing Co., Providence, R. I. Price 50 cents.

PART 2. STUDENT'S INSTRUCTION SHEETS

GENERAL DIRECTIONS

The drill press is one of the most universally used machines of the general machine shop. It is probably the machine on which most apprentices are started.

As in every other machine tool the first thing is to become familiar with the machine, its speeds, feeds, and the methods of handling.

There are various kinds of drill presses described in I. C. S., "Drilling," section 14, pages 1-9. The most common are sensitive drill, common drill, radial drill, multiple spindle drill.

Drills are of various kinds as in I. C. S., section 13, pages 1-21. The most common are the flat and twist drills.

Lesson I.—Drills and drill presses

1. Read I. C. S., "Drilling," sections 13 and 14. "Starrett Book," pages 47-63.
2. Learn the parts and their uses by inspection of all the drill presses available.
3. Methods of holding drills:
 - (a) Flat drills, generally used on chuck work in a lathe. The drill is supported on the dead center and prevented from turning by a drill dog clamped in the tool post.
 - (b) Straight-shank drills, held in a drill chuck.
 - (c) Taper-shank drills, held in a taper socket in the drill press spindle.
 - (d) Square taper shank. For use in ratchets and bit braces.
4. Most work requires strapping to the table or platen of the press. The method of holding work varies with the character and shape of the work and often calls for much ingenuity. Very often the proper mounting of the work will require a large per cent of the time required for the job.

V-blocks, angle plates, parallel strips, clamps, jigs, and fixtures are used in such variety that it is impossible to cover the field in this bulletin.

5. *Grinding drills.*—The angle of the cutting edge to the axis of the drill is about 60 degrees or the included angle 120 degrees. Each edge should have the same angle and be of the same length. For directions for grinding, see I. C. S., "Drilling," section 14, pages 31-34. If one lip is longer than the other, the drill will make a hole larger than the body of the drill.

Questions

1. Can a drill make a hole larger than the size of the drill?
2. If so, how is it done? Why?
3. What is the advantage of a twist drill over a flat drill?

Lesson II.—Drilling two $\frac{5}{8}$ -inch holes 1 inch apart

Refer to the Starrett Book, pages 47-63 for methods of laying off.

1. *Lay out the holes.*—The distance between holes refers to the distance between centers. Chalk the surface where the holes are to be. Prick punch the center (a) of the first hole. (A prick punch has a more acute angle at the point and is usually lighter than the center punch. *Keep it sharp.*) With the dividers set at $\frac{5}{16}$ -inch, scribe a circle as at (a) Figure 1. With (a) as a center and a radius of 1 inch, scribe an arc (d). A center anywhere in this arc will be 1 inch from (a). Scribe a $\frac{5}{8}$ -inch circle with center in (d) for the second hole. With the prick punch make proof marks in each circle as shown. An easy method of measuring the distance between two holes with a scale is to measure between the same side of each hole, as (e) to (e). (Fig. 1.)

2. *Start the drill for the first hole.*—Enlarge the center by using the center punch. Start the drill in the center-punch mark. Before the corner of the lip is down to the surface of the work lift the drill and see if the cut is concentric with the layout. If not, the drill must be “drawn.” This is done by cutting the metal away on the side toward which the drill should go, as at (b). (See fig. 2.) Then feed the drill in slowly and it will shift in the direction desired. The groove in the side of the conical hole may be cut with a small round nose chisel, but most mechanics use their center punch for this, as it is generally at hand. The “drawing” must be done *before* the corner of the lip of the drill is cutting. After the drill is properly located it is fed through the piece.

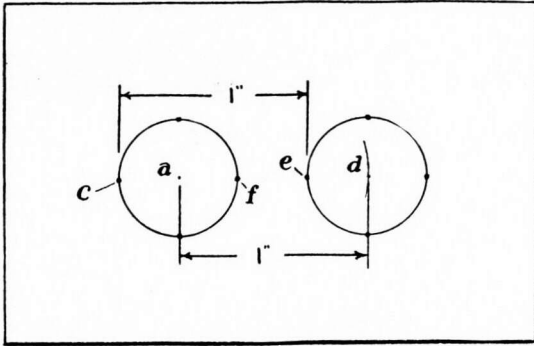


FIG. 1

surfaces it is customary to clean the surface of the metal and wet it with copper sulphate (blue vitriol solution). When this dries it leaves a coppered surface that shows the scribed lines clearly and accurately.

Questions

1. What is meant by “drawing” a drill?
2. How is it done?
3. How should a piece of work be mounted to prevent drilling into the table?
4. Name three different kinds of drill presses.
5. How should you hold a flat drill?
6. What is the difference between countersinking and counterboring?
7. What is a drill collet?

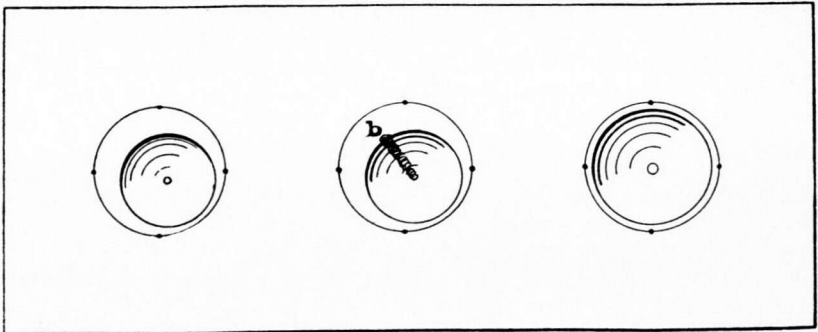


FIG. 2.—Starting and drawing a drill

Lesson III.—Drill six $\frac{3}{4}$ -inch holes in a cast-iron washer

NOTE.—These washers are stock articles and not expensive. If they can be faced in a lathe they will be better for this work.

Review references for previous lesson.

1. Fit a block of wood tightly in the center hole and tack a piece of tin on this block on which to locate the center of the washer. Center carefully. Prick punch this center in the tin very lightly. From this center, with a pair of sharp dividers, scribe the $\frac{2}{4}$ -inch circle

on which the holes are to be located, chalk the surface carefully, and rub the chalk well into the surface of the iron with the fingers. (If the washer has been faced, it may be coppered with blue vitriol.) Measure off the center distances on this circle and lay out the $\frac{3}{4}$ -inch holes with care. Make the proof marks exactly on the circles.

2. Knock out the center and use the hole to bolt the washer onto the drill press table. Drill with care, as directed in Lesson II.

3. Test for accuracy.

Questions

1. How do you lay off six holes on a circle equidistant from each other?
2. By drawing lines from the center of two adjacent holes to the center of the large circle, what angle is formed, as at (B), Figure 3?
3. If we connect the centers of three adjacent holes, what angle is formed, as at (A), Figure 3?
4. To test, turn the washer face down on a piece of tin and scribe the holes, then turn through one or two spaces. If the holes have been accurately laid off and drilled, the holes will exactly coincide with the circles drawn on the tin, whichever holes are put in register.

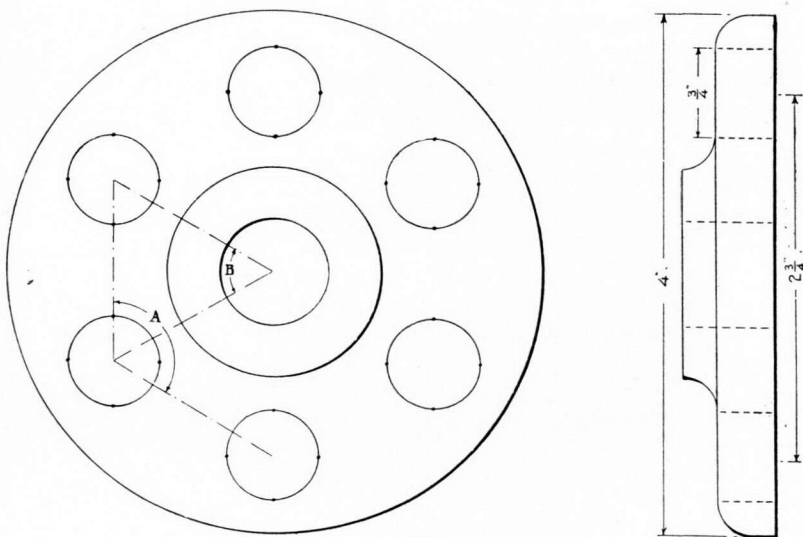


FIG. 3

Lesson IV.—Side-hill drilling

To drill into a surface when the drill makes an acute angle with the surface. (See fig. 4.) Review references for previous lessons, I. C. S., "Drilling," section 13, pages 30-35.

1. The holes are laid out by cross lines as shown. Mark the centers and scribe circles.
2. Carefully chip out the metal at (a) until a level surface is formed on which to start the drill.

3. Drill as in Lessons II and III.

If a number of holes of this kind are to be drilled, it is often a saving of time to chip off a smaller surface than is required; locate the center, drill a smaller lead hole and sweep off the surface with some form of counterbore. As the counterbore is guided by the projection that fits the lead hole, it is necessary to locate this lead hole with care.

Questions

1. Will a circle scribed on a surface be followed by the drill that goes in at an acute angle to the surface?
2. Why do we have difficulty in starting a drill accurately on a side-hill surface?

Lesson V.—Tapping

Read: I. C. S., "Drilling," section 14, pages 49-52.

TAPPING A BLIND HOLE

1. Select the proper tap drill. The diameter of the tap drill is the root diameter of the thread on the tap.
2. Locate and drill the hole. Gauge the depth from the point where the corner of the lip begins to cut. The depth can be measured on the sleeve of the drill press. Do not scratch this sleeve to give a line to measure from. A lead-pencil mark is usually sufficient. Many drill presses have graduated sleeves for this purpose.
3. Clean out the drill chips before tapping. If the work can not be turned over, the chips may be removed by blowing with a small bellows or removed with a small bar magnet. Do not blow out with the mouth.
4. Tap, first with a taper tap, then with a plug tap, and finally with a bottoming tap if it is necessary to have the thread extend to the bottom of the hole. Before bottoming it is necessary again to remove the chips. Use great care not to break the tap when it strikes bottom. With small sizes there is considerable danger of breaking the tap. This is partic-

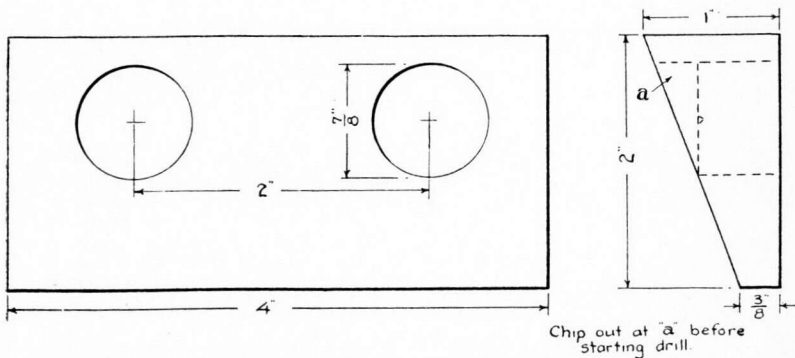


FIG. 4.—Side-hill drilling

ularly true in backing out the tap. A broken tap may often be backed out with a punch or a dull cold chisel. Sometimes the temper must be drawn by heat and the tap drilled out.

In tapping through holes the plug and bottoming taps are often not used at all.

Questions

1. Describe taper, plug, and bottoming taps.
2. If you have no table showing tap drill sizes, how will you find the size of drill to use before tapping? (See Hand Book for Apprenticed Machinists, Brown & Sharpe, p. 57.) Double the depth of standard threads is usually stamped on the 60° center gauge.
3. Why run the drill slower when drilling thin plate, especially when the work is resting on a wooden block?
4. What is a tap drill?

Lesson VI.—Removing broken studs, screws, and taps

If the stud or screw extends above the surface into which it is screwed it can usually be removed by the use of a pipe wrench or sometimes by the skillful use of the hammer and chisel or punch.

If the stud or screw is broken off flush with the surface or even below this surface it is more difficult to remove.

For soft screws and studs:

1. Center punch the screw.

2. Drill out the center as nearly concentric with the screw as possible, using a drill about two-thirds the diameter of the screw to be removed.

3. Make a four-sided taper punch that can be driven lightly into the hole and then back the screw out by a wrench applied to the punch.

If the punch is given a left-hand twist in making it, the act of turning the screw out will cause the punch to seat more firmly in the hole.

Such a left-hand twisted tool is on the market and will be found of great help.

If the broken screw is hard or is a broken tap, it will be necessary to draw the temper before drilling. This is usually done by heating the piece in a forge, if the piece is small, or by torches, blowpipes, or other methods of local heating. After softening, drill and remove as described above.

Rehabilitation monograph. Joint Series No. 20.

Unit Course—Machine Shop Practice VI—Accurate Measuring

ACCURATE MEASURING

February, 1919—Trial edition

PART 1. TEACHERS' MANUAL

1. QUALIFICATION OF STUDENTS

Anyone with a desire to become familiar with measuring tools and learn to measure accurately may take this course with profit. He should be able to work with common fractions and decimals.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

This is a good preliminary training for inspectors, tool, or instrument makers.

3. TIME REQUIRED

Twenty-five hours or more. The more time given the more skill attained.

4. EQUIPMENT

Tray $5\frac{1}{4}$ by $8\frac{1}{4}$ by $1\frac{1}{4}$ inches inside. Figure A.

1-inch micrometer calipers (graduated to ten-thousandths).

4-inch outside spring calipers.

4-inch inside spring calipers.

6-inch steel scale.

Assorted steel balls $\frac{1}{8}$ to 1 inch by sixteenths.

5 by 8 inch cards. (See pp. 12 and 13.)

Pencil.

Small pieces of rolled brass of various thicknesses (have the brass cut to about $\frac{3}{4}$ by $1\frac{1}{2}$ inches and all burr removed from the edges).

Short pieces of cold-drawn tubing 1 inch, $1\frac{1}{4}$ inches, $1\frac{1}{2}$ inches, $1\frac{3}{4}$ inches, 2 inches diameter. Have these thimbles cut from fairly heavy gage tubing (steel or brass) and the burrs removed. Caution that they are not mashed or dented.

5. STANDARDS FOR MEASURING AND RECORDING PROFICIENCY OF STUDENTS

See "Measuring, Rating, and Recording Student's Work" in Teacher's Manual for Unit Course, Machine Shop Practice I.

6. OUTLINE OF LESSONS

Lesson 1. Outside calipers.
 Lesson 2. Inside calipers.
 Lesson 3. Reading micrometer calipers.
 Lesson 4. Use of the micrometer.
 Lesson 5. Measuring tubing.
 Lesson 6. Measure tubing with the "Mike."
 Lesson 7. "Feel" 1/1000 inch with outside calipers.

Lesson 8. "Feel" 1/1000 inch with inside calipers.
 Lesson 9. Transferring sizes.
 Lesson 10. Inside caliper.
 Lesson 11. Decimal equivalents.
 Lesson 12. Reading the "Mike" closer than 1/1000 inch.

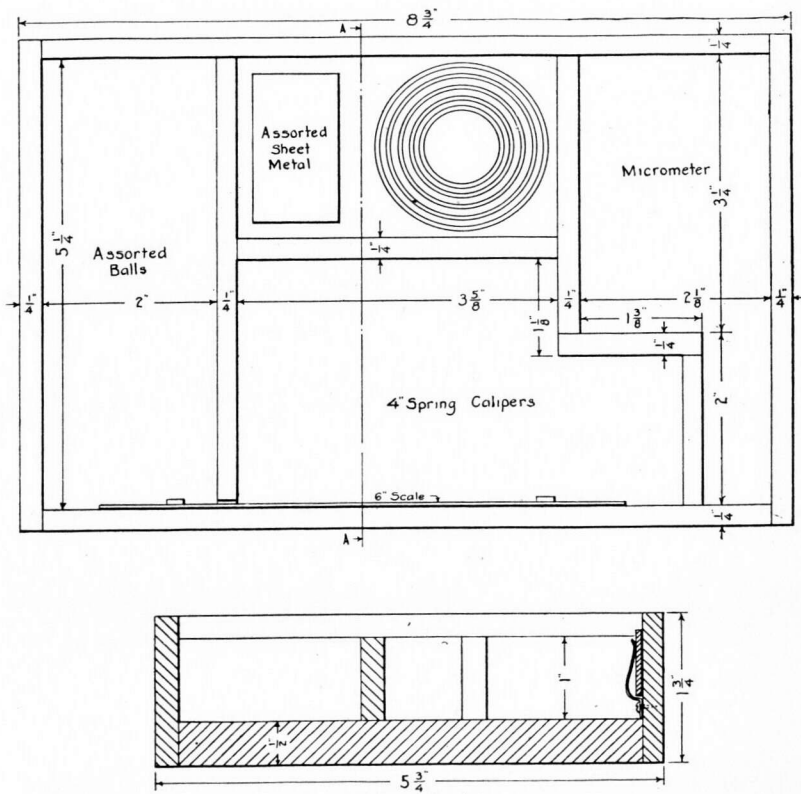


FIG. A.—Measuring outfit

7. SUGGESTIONS FOR INSTRUCTORS

In Lesson 6, the thickness of the wall of tubing is called for as measured by the "Mike." Let the man find out by trying that he can not measure the wall of small pipe with the "Mike" without error due to the curvature of the tube. If he does not see the trouble, show him, and let him figure a way of overcoming the difficulty. The use of a steel ball is an easy way out of the trouble, as indicated in the Figure B.

The student and the instructor will think of many additional problems in measuring. It is suggested that the instructor measure the pieces that are found in the regular outfit and record them for use in checking the results of the students. The pieces can be numbered so they need not be the same in each set.

Have the student record his measurements on the 5 by 8 inch cards and turn them in for inspection.

A vernier caliper can be added to the outfit and increase the range of work possible.

If this work is given in the hospital, the tray containing the outfit can be given to the student, and by the help of the instruction sheets he should be able, with a little help, to secure very valuable practice in measuring.



FIG. B

ACCURATE MEASUREMENTS

(See instruction sheets)

LESSON I. *Outside calipers*

Number of trials
 Question 1
 2

LESSON II. *Inside calipers*

Question 1
 2

LESSON III. *Reading the micrometer caliper*

Question 1
 2

LESSON IV. *Using the "Mike"*

Thickness of		
Cigarette paper	.....	Penny
Postal card	.....	Nickel (1895)
Student's hair	.....	Buffalo nickel
Student's eyebrow	.....	Dime (1905)
Neighbor's hair	.....	Dime (1918)
Question 1	.....
2	.....
3	.....

LESSON V. *Measure tubing-plain calipers*

Outside diameter	.....	Double thickness of wall
Inside diameter	.....	Single thickness of wall

LESSON VI. *Measure tubing "Mike"*

Thickness plus ball
 Diameter of ball
 Thickness of wall
 Question 1
 2

LESSON VII. *Thickness of cigarette paper, etc.*

Question 1
 2

(Reverse side of card)

LESSON VIII. "Feel" 1/1000 inch

Question 1. Number of trials-----
 2. Lines correct-----

LESSON IX. Transfer lines

	Case 1	Case 2
Inside caliper by "Mike"-----	-----	-----
Diameter of ball by "Mike"-----	-----	-----
Error-----	-----	-----

LESSON X. Inside calipering

Inside diameter by inside caliper and "Mike"-----	-----
Outside diameter by "Mike" or spring caliper-----	-----
Thickness of wall with "Mike"-----	-----
Calculated diameter:-----	-----
Error with inside caliper-----	-----

LESSON XI. Decimal equivalents

Fraction	Inside caliper set to scale	Calculated error
1/4 inch-----	-----	-----
5/16 inch-----	-----	-----
3/8 inch-----	-----	-----
7/16 inch-----	-----	-----
1/2 inch-----	-----	-----
9/16 inch-----	-----	-----
5/8 inch-----	-----	-----
11/16 inch-----	-----	-----
3/4 inch-----	-----	-----
13/16 inch-----	-----	-----
7/8 inch-----	-----	-----
15/16 inch-----	-----	-----

LESSON XII. Reading ten thousandths

Question 1-----
 2-----
 3-----
 4-----
 5-----
 Student's name-----
 Ward-----

NOTE.—Cards 5 x 8 inches in size (not furnished by the Federal Board for Vocational Education) should be printed as above and form part of the equipment. One or more of these cards should be in the tray when handed to the student. He will record the results of his work on the card to be inspected and graded by the teacher.

8. REFERENCES

Machinery Hand Book: Industrial Press, New York, \$6.

One of the standard reference books on machine shop work.

American Machinists' Hand Book: McGraw Hill Book Co., New York, \$3.

A standard reference book for the use of machinists.

The Sterrett Book: L. S. Sterrett Co., Athol, Mass., 75 cents.

A good book for apprentices and others in machine work.

J. T. Slocomb Co.'s Catalog and Measuring Book No. 15: J. T. Slocomb Co., Providence, R. I.

Gages, Gaging and Inspection, Douglas T. Hamilton: The Industrial Press, New York, \$2.50.

A comprehensive treatment of inspection. Good for those who have had shop experience.

Combination Gage Blocks, Johansson: The Swedish Gage Co. (Inc.), 245 West 55th Street, New York.

A very interesting and instructive catalog on accurate measuring and measuring tools.

PART 2. STUDENT INSTRUCTION SHEETS

INTRODUCTION

Measuring has become almost a fine art. Such units as the "hand" and "span" are still in use but they have had a definite value assigned to them. The standard foot at one time was the length of King Arthur's foot—rather indefinite and hard to use. Now we measure to 1/10,000 of an inch in much work and for some work very much finer than this. Gages may be purchased that are correct to 1/100,000 of an inch. See "Johansson Gages," Swedish Gage Company's catalog. Many persons think 1/64 inch is a very small amount. It depends on the work being measured. If the height of a brick wall was measured to 1/64 inch it would be very close. If the fit of a gas engine piston was no closer than 1/64 inch it would not do at all.

1. GENERAL DIRECTIONS

Measurements that are to be accurate are usually taken in decimals. Our old standard division of the inch into 1/4's, 1/8's, 1/16's, 1/32's, 1/64's, etc., is inconvenient. The micrometer reads in thousandths or ten thousandths. A table of decimal equivalents is convenient. See Slocumb Catalog and Measuring Book, page 113. Read Machinery Reference Book No. 21, pages 3-10. Delicate touch is very necessary in using the ordinary calipers, and this is to be cultivated.

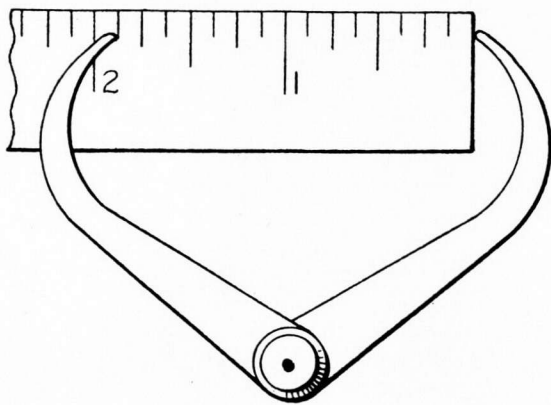


FIG. 1

Lesson 1. Outside calipers

1. Set the outside calipers to 1-inch size by the steel scale.

To do this place one leg of the outside caliper against the end of the scale and adjust the calipers so the other leg is at the 1-inch graduation. The graduation line is several thousandths thick. The eye must be trained to set the leg so just half of the graduation line shows between the legs. See Figure 1. The points of the legs must be in a line parallel to the edge of the scale.

2. Test by the 1-inch steel ball. These balls are very accurate considering their price probably with much less than 1/1,000-inch error.

3. Continue to practice setting the calipers to various sizes and test as above.

The calipers are not forced when placed on the scale. They must not be forced when placed on the ball. Have them just touch at both legs. Here is a chance to cultivate a delicate sense of touch. Hold the calipers very lightly with the tips of the fingers. The tips of the fingers are much more sensitive.

In calipering the 1-inch ball, if the calipers come in contact at *a* and *b* (fig. 2), we measure a true diameter. If the calipers touch $\frac{1}{8}$ inch before the diameter is reached, as at *a'b'*, instead of *ab*, they can easily be sprung over the ball, but when tested on the scale will read less than the diameter. The length of *a'b'*, $\frac{1}{8}$ inch away from a diameter on a 1-inch ball is 0.99215 inch instead of 1 inch, an error of 0.00785 inch, or nearly 0.008 inch, due to spring of calipers.

In calipering cylindrical work with outside calipers it is necessary to measure a diameter and not some other dimension. In Figure 3 it is the diameter ab and not cd or ef that is to be measured. To secure this hold the calipers very lightly by the head and swing them from side to side until the least dimension is found. Then set the calipers so the contact can just be felt. (This error is more apt to be made when calipering large pieces.)

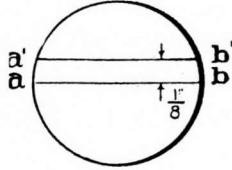


FIG. 2

Questions

1. Why are we more apt to make an error with large pieces than with small ones?
2. Why are small, light calipers more accurate than large ones?

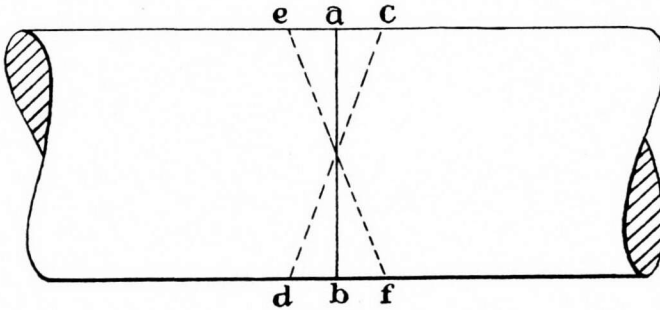


FIG. 3

Lesson 2. Inside calipers

Caliper the inside of the $1\frac{1}{2}$ " thimble.

1. Set the inside calipers approximately to size.
2. Try in the tube. Swing from side to side, as in Figure 4, ab , ae , and ad , and move one leg back and forth as at $a'd'$, $a'b'$, and $a'e'$, adjusting the calipers until they just touch at a diameter $a'b'$. Set so you can "feel" contact very lightly at this point.

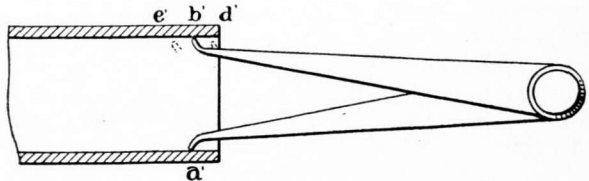
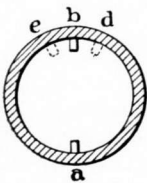


FIG. 4

3. Measure this setting by the steel scale. In doing this the end of the scale is usually held perpendicularly against some convenient finished surface. One leg of the caliper is rested against the finished surface close to one corner of the scale. The scale is read at the position of the other leg. See Figure 6. The line connecting the measuring points must be parallel with the edge of the scale as with the outside calipers.

If the scale is not held perpendicular to the surface an error is introduced as shown in Figure 5.

To avoid this chance of error a good method is to place the scale on the blade of a steel square, as shown in Figure 6. Then the calipers may be placed with one toe against the head of the square and the other on the scale, Figure 6. This insures that the scale is perpendicular to the surface and that there is a good finished surface to rest both the scale and calipers against.

Questions

1. What errors are liable to be made in using the inside calipers?
2. What is the necessary line of sight when reading, by a scale, the set of a pair of calipers?

Lesson 3. Reading micrometer caliper

The micrometer caliper is an instrument used to make accurate measurements by use of a graduated screw.

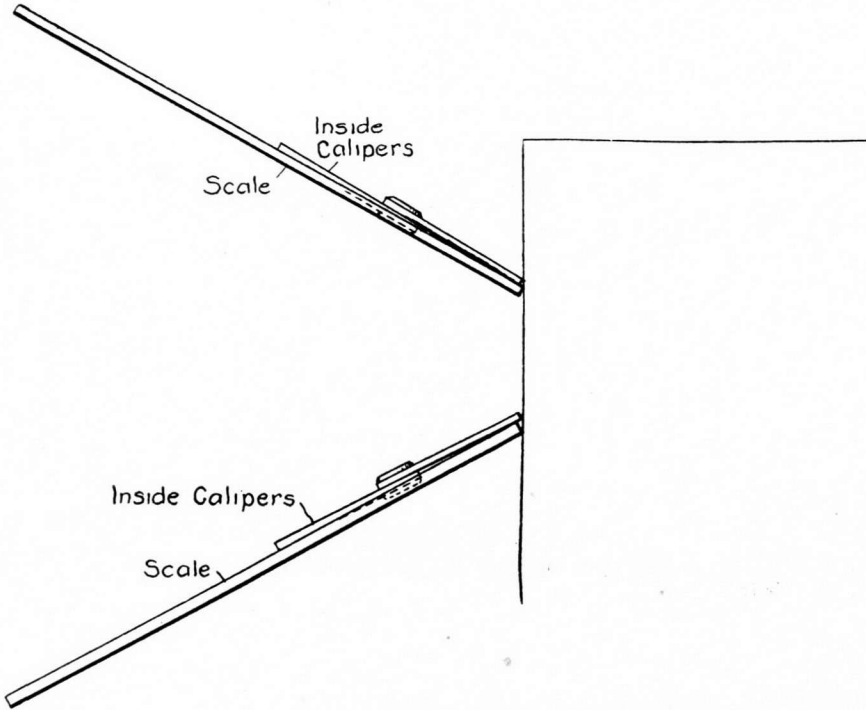


FIG. 5

The range of adjustment of a micrometer caliper is usually 1 inch. The caliper we will use has a range from 0 inch to 1 inch.

Read J. T. Slocomb's Catalog and Measuring Book, pages 83-84; also, The Starrett's Book, pages 19-22.

The screw in the micrometer has 40 threads per inch. One turn of the screw will advance the spindle $\frac{1}{40}$ inch or 0.025 of an inch. There are 25 spaces on the edge of the thimble C, Figure 7, by which the screw is turned. Each of these spaces is therefore $\frac{1}{25}$ of a turn or $\frac{1}{25}$ of $\frac{1}{40}$, or $\frac{1}{1000}$ inch. Thus the micrometer gives direct readings to the nearest $\frac{1}{1000}$ of an inch. The sleeve B is graduated in fortieths to correspond to the threads of the screw. Every fourth graduation mark is made longer and numbered 1, 2, 3, etc. Four of the short spaces measure $\frac{4}{40}$ inch or $\frac{1}{10}$ inch.

To use the micrometer:

1. Adjust the screw until the caliper will pass over the piece being measured with an easy friction.

2. Reading the caliper. Suppose the setting is as in Figure 7. The thimble has uncovered 4 long graduation marks and 3 short ones on the sleeve B, also passed 12 graduations from 0 on the thimble C.

The 4 long graduations on the sleeve indicate	0.4 inch.
The 3 short graduations on the sleeve indicate $3 \times .025$ .....	.075 inch.
The 12 graduations on the thimble indicate .....	.012 inch.
Total .....	.487 inch.

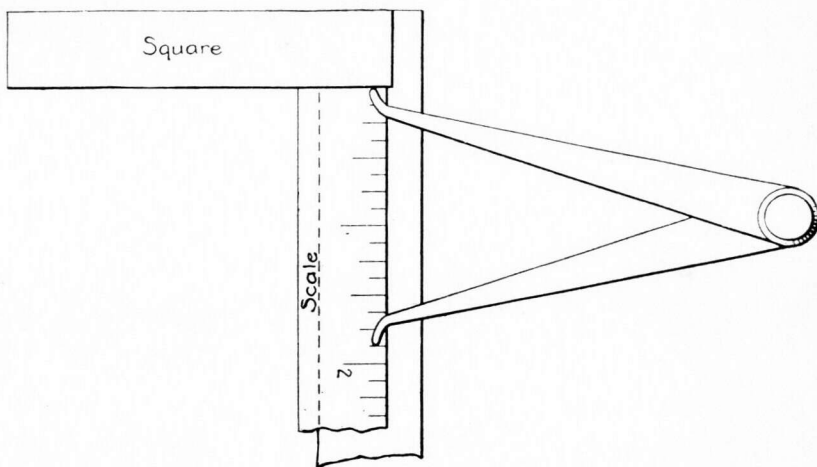


FIG. 6

With a little practice the caliper can be read without putting the separate figures down and adding them.

Practice reading miscellaneous settings until you can read the "Mike" accurately and quickly.

Questions

1. What is the pitch of the screw used in the micrometer caliper?
2. Why is this pitch used?

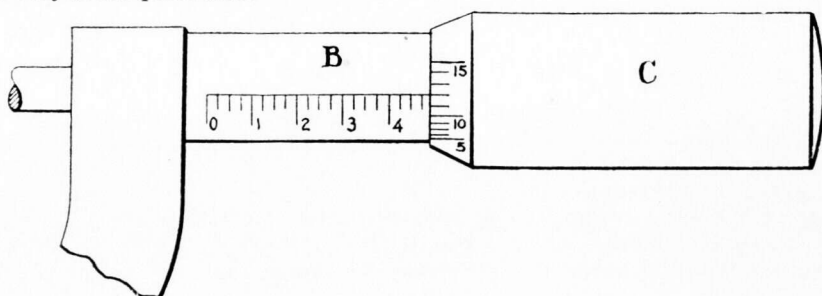


FIG. 7

Lesson 4. Use of the micrometer

Measure the following and record the thickness: Cigarette paper, postal card, hair from your head, eye brow, hair from your neighbor, penny, dime, quarter, etc.

Questions

1. Do human hairs vary in size?
2. What is the range of size?
3. Are dark hairs coarser or finer than light hairs?

Lesson 5. Measure tubing

1. Measure the thickness of wall in the short pieces of tubing in your set. Use outside and inside calipers and steel scale.
2. Calculate the thickness of the wall from outside and inside diameters as measured.
3. Compare with a sheet metal gauge. (See American Machinist's Hand Book, p. 411, or other reference table.)

Questions

Is No. 16 gauge steel thicker or thinner than No. 18?

Is No. 16 gauge wire larger or smaller than No. 18 wire?

Lesson 6. Measure tubing with micrometer

1. Measure the thickness of wall by calipering with the "Mike."
2. Compare with the thickness found in lesson 5.

Questions

What difficulty is met particularly with the small sizes of tube?

How is it overcome?

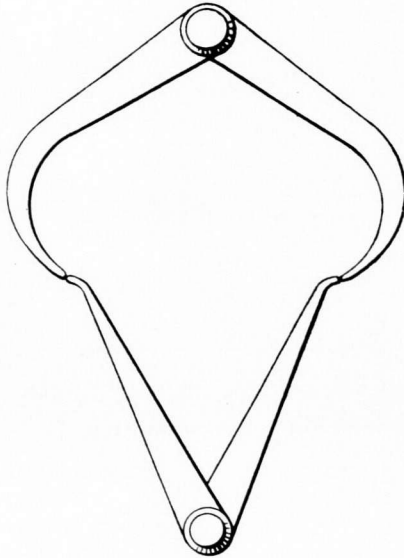


FIG. 8

Lesson 7. "Feel" $\frac{1}{1000}$ of an inch with outside calipers

1. Measure a cigarette paper with the "Mike."
2. Caliper a steel ball or other finished piece with outside calipers.
3. Place one thickness of cigarette paper between one leg of the calipers and the ball or piece being measured and note the difference in "feel."

Question

How small a difference can you detect with the spring calipers?

Lesson 8. "Feel" $\frac{1}{1000}$ of an inch with inside calipers

1. Open the "Mike" to any convenient size.
 2. Set the inside calipers carefully to fit the "Mike."
 3. Pass the "Mike" to your neighbor with instructions to change it $\frac{1}{1000}$ inch.
 4. See if you can tell which way it has been changed by testing with the inside calipers.
- (This is fine practice to educate the touch.)

Lesson 9. Transferring sizes

1. Caliper a $\frac{7}{8}$ -inch ball with the outside calipers.
2. Transfer the size to the inside calipers. (See fig. 8.)
3. Test the inside calipers with the "Mike."
4. Caliper the ball with the "Mike" and compare to see what errors have been made in calipering and transferring sizes. (Skill in transferring is very important.)

Lesson 10. Inside calipering

1. Caliper the inside diameter of a piece of steel tube with the inside calipers.
2. Measure the inside caliper with the scale and then with the "Mike."
3. Measure the outside diameter with the outside calipers and test for accuracy with the "Mike."
4. Measure the thickness of wall with the "Mike."
5. Calculate the inside diameter and check the measure taken with the inside calipers.

Lesson 11. Decimal equivalents

1. Set the inside calipers to $\frac{1}{4}$ -inch, $\frac{5}{16}$ -inch, $\frac{3}{8}$ -inch, $\frac{7}{16}$ -inch, $\frac{1}{2}$ -inch, etc., by the steel scale.

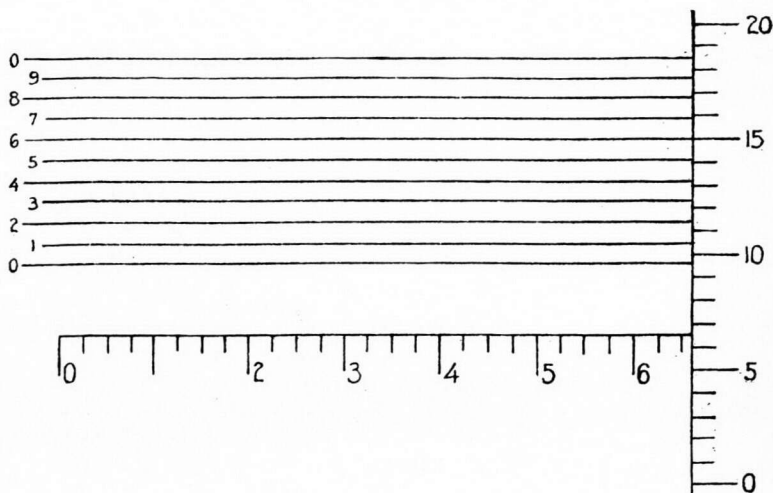


FIG. 9

2. Test each setting by the "Mike" and record the readings.
3. Figure out the decimal equivalents for these fractions and compare with the "Mike" readings in (2).

Lesson 12. Reading the "Mike" closer than $\frac{1}{10000}$ -inch

1. Divide the thimble graduations of the micrometer caliper by eye into fourths and read quarter thousandths.

Micrometers are often provided with a vernier to read to $\frac{1}{10000}$ -inch.

This vernier reading is secured by the use of 11 parallel lines drawn on the sleeve of the caliper. These lines are numbered 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. The 10 equal spaces formed by these lines are together equal in size to nine spaces on the thimble. Each space on the vernier is therefore smaller by $\frac{1}{10}$ of a space than the space on the thimble. As the thimble space indicates $\frac{1}{1000}$ inch the space on the vernier is $\frac{1}{10000}$ inch smaller.

Read the Starrett Book, page 23. Read J. T. Slocomb's Catalog and Measuring Book, page 98.

For example, in the Figure B, Slocomb's Catalog and Measuring Book, page 98, the 0 line on the thimble coincides with the base line of the longitudinal scale on the sleeve. The 0 line of the vernier coincides with a third line on the thimble. If the caliper is opened $\frac{1}{10000}$

inch the No. 1 line of the vernier will correspond to the fourth line in the thimble. If opened $\frac{2}{10000}$ inch the No. 2 line on the sleeve will coincide with the fifth line of the thimble, etc. For a setting shown in Figure 9 we have opened the caliper two spaces past the .6 mark on the sleeve, 6 spaces on the thimble, and No. 6 line on the vernier coincides with a line on the thimble. This setting will then read $.6 + 2 \times .025 + .006 + .0006 = .6566$ inch.

A little practice with the caliper will enable the operator to read this readily.

Read Swedish Gage Company's Catalog of Johansson Gages. These gauges are acknowledged as the most accurate gauges in everyday commercial use.

Question

1. What is meant by "Limit gauges"?
2. What is "Tolerance"?
3. What tolerance is allowed in the Johansson gauges?
4. What holds the blocks together when they are slid one over the other in combining them?
5. What is the range of sizes possible with the 81 block set?

Rehabilitation monograph. Joint Series No. 21.

Unit Course—Machine Shop Practice VII—Mathematics for the Engine Lathe

MATHEMATICS FOR THE ENGINE LATHE

January, 1919—(Trial edition)

PART 1. TEACHER'S MANUAL

QUALIFICATIONS OF THE STUDENT

This series of lessons is intended for men who have had a fair amount of experience in lathe work. The lessons may also be given contemporaneously to beginners in a course of instruction in lathe practice. If so given, the order of presentation of topics should be such that the calculations will supplement actual lathe practice.

It is supposed that the student has received the usual training in arithmetic given in the grammar school. This training is generally so far removed from practice in the trade that most of it has been forgotten. The foundation in arithmetic has already been laid, however, and a little review will bring the student to the stage where he will profit by further instruction.

The student should always be approached from the practical side. For example, the instructor should not emphasize fractions as such, but he should impress upon the student the necessity for calculating the right length of a piece of stock in order to avoid waste of material.

ADVANTAGES TO BE DERIVED BY THE STUDENT

A good working knowledge of the calculations involved in lathe practice will enable the machinist to perform the greater part of all necessary machine-shop calculations. With the exception of a few problems in gears and milling machine practice, there is little calculation outside of lathe work that need claim the attention of the average machinist. This course is planned to give this fundamental training in lathe calculations.

LENGTH OF THE COURSE

There are 20 lessons in the course, each planned to occupy about 1 hour of the student's time. A sufficient number of practice problems have been listed in each lesson to enable the instructor to regulate the amount of work for the needs of the individual student.

MATERIALS AND EQUIPMENT

Most of the lessons require only the textbook, paper, and pencil. For lesson No. 4 a ruler and an ordinary school compass should be provided. Lesson No. 9 requires a machinist's bevel protractor like that described in the text. Lesson No. 20 requires a micrometer caliper.

STANDARDS FOR MEASURING AND RECORDING

The progress of the student may be tested at intervals by a written examination. The percentage basis may be used for rating and recording results.

OUTLINE OF LESSONS

- Lesson No. 1.*—Calculation of stock (addition, subtraction of fractions).
Lesson No. 2.—Calculation of stock (multiplication, division of fractions).
Lesson No. 3.—Calculation of stock (decimal fractions).
Lesson No. 4.—Laying out work (simple geometry).
Lesson No. 5.—Cutting speed.
Lesson No. 6.—Cutting feed; time for cuts.
Lesson No. 7.—Tapers.
Lesson No. 8.—Taper turning (offset method).
Lesson No. 9.—Compound rest; angles; bevel protractor.
Lesson No. 10.—Square root (preparation for threads).
Lesson No. 11.—Right angle triangle.
Lesson No. 12.—Sharp or V thread.
Lesson No. 13.—United States standard thread.
Lesson No. 14.—Calculation of drill sizes for taps.
Lesson No. 15.—Square, Acme, Brown & Sharpe, worm threads.
Lesson No. 16.—Change gears for thread cutting (simple).
Lesson No. 17.—Change gears for thread cutting (compounding).
Lesson No. 18.—Ratio and proportion; gear trains.
Lesson No. 19.—Pulley trains; belting.
Lesson No. 20.—Micrometer caliper.

Text and reference books

Author	Title	Publisher	Price
Burnham.....	Mathematics for machinists.....	John Wiley & Sons, 432 Fourth Avenue, New York City.....	\$1. 25
Colvin.....	Machine-shop calculations.....	McGraw Hill Book Co., 239 West Thirty-ninth Street, New York City.	-----
Marsh.....	Industrial mathematics.....	John Wiley & Sons.....	-----

LESSON SUGGESTIONS

Lesson No. 1.—Experience has shown that the best starting point for men in the machine trades, who wish to study the applied mathematics of their trade, is a review of common fractions. This lesson is intended for review and practice in addition and subtraction of common fractions and mixed numbers. An attempt has been made to select practical problems; quite a number of them are taken from shop drawings. The instructor should keep the attention of the student focused on the practical rather than on the theoretical side of the lesson.

Lesson No. 2.—This lesson is a continuation of lesson No. 1, and deals specifically with the multiplication and division of fractions and mixed numbers. As in lesson No. 1, the attention of the student should be directed toward the practical side of the work.

Lesson No. 3.—This lesson is intended for review and practice in decimal fractions; also for practice in conversion of common fractions to decimals and vice versa. Particular attention should be given to the placing of the decimal point. In making measurements, the machinist frequently deals with dimensions in thousandths of inches; he should, therefore, acquire facility in converting eighths, sixteenths, thirty-seconds, and sixty-fourths into corresponding decimals.

Lesson No. 4.—It is difficult in a lesson of this kind to have the teaching “carry over” into practical application. The student apparently understands a construction on paper, but fails to recognize the same construction when it is applied to laying out work in the shop. Turning the figures at different angles helps some. A good method is to have the student lay out work on circular and rectangular blocks of wood if nothing better is available.

Lesson No. 5.—The average machinist has learned by experience about what cutting speed to use on a piece of work. The teacher should impress upon the student that cutting speeds are not to be found by guesswork; that there are efficient speeds for different metals; and that the work is being done more efficiently when the proper speed is maintained. Speeds given in handbooks have been determined by tests; they are a safe guide for the man who can not make tests for himself.

Lesson No. 6.—In many shops it is a common practice to feed a machine as much as it will stand. The student should know that the man who "jams" a piece of work through is often doing much harm to the machine. It may not show at the moment, but sooner or later some part of the machine will break under the strain and the repair bill will more than offset the value of any time that has been saved on the job. The combination problems in speeds and feeds and the calculation of the time necessary for a given cut, will serve to turn the thoughts of the student to the subject of cost production.

Lesson No. 7.—Two ideas in this lesson are hard for the student to grasp: First, that the same taper may be cut on different diameters; second, that the same taper may be cut to any desired length. The student should be taught to express a taper with equal facility, as inches per foot or inches per inch.

Lesson No. 8.—The instructor must constantly emphasize the statement that "the set-over of the tailstock is always reckoned on the entire length of the piece between centers." The student persists in thinking that the length of taper cut has something to do with the set-over. The student must be taught to think about the problems and not attempt to use in some way every number that is stated in the problem.

Lesson No. 9.—In using the bevel protractor, the machinist is sometimes obliged to use a complementary angle to the one stated on a drawing. The student should know how to set the protractor for both complementary and supplementary angles. The same thing is true for the compound rest. Some difficulty will be experienced in getting the student to read the vernier properly, also in getting him to use the bevel protractor in different positions.

Lesson No. 10.—The aim of this lesson is to teach only the process of finding the square root of a number. Mechanics always display considerable interest in square and cube root. A knowledge of square root is essential to the undertaking of some of the lessons that follow.

Lesson No. 11.—This lesson also appeals strongly to mechanics. This is due perhaps not so much to the fact that it has so many practical applications as to the fact that most of the men consider it a mathematical stunt.

Lesson No. 12.—Three elements of interest appear in this lesson—square root, the right triangle, and a touch of the algebraic equation. After mastering the lesson, the mechanic feels that he is getting a real grip on mathematics.

Lesson No. 13.—The difficulty in this lesson is to have the student understand how much of the thread is taken away at the top and bottom. He usually gets confused and persists in thinking that one-eighth of an inch is taken away from each part. A good way of correcting the error is to let the student make calculations on a small thread. He soon discovers that one-eighth of an inch would take away nearly the whole thread.

Lesson No. 14.—In this lesson, proper placing of the decimal point becomes troublesome. There is also difficulty of knowing how many decimal places to keep in getting results. If the student compares his results with those given in handbook tables, he is doubtful about his work. The instructor should make clear to the student the reason for any variation in answers to problems.

Lesson No. 15.—This lesson offers an opportunity for teaching the use of formulas. The average mechanic learns how to use a few formulas just as they are given in a handbook. He frequently does not know the real meaning of the letters and has no conception of constants.

Lesson No. 16.—Impress upon the student that he must know the "lead" of a lathe before he can make any calculations for change gears. He needs also to avoid confusion by carefully labeling "stud" and "screw" gears at each stage of his calculations.

Lesson No. 17.—The method of compounding in this lesson deals mainly with the 2-to-1 ratio. No attempt is made to teach the method of splitting ratios. There is very little need for machinists to go much beyond the problems outlined in this lesson, as far as thread cutting is concerned.

Lesson No. 18.—The subject of ratio and proportion has been carefully avoided up to this point. Problems in gear trains can not be easily handled without proportion, so that the lesson is necessary. An attempt has been made to keep the problem as practical as possible.

Lesson No. 19.—After the lesson on gear trains, there is nothing new to teach on the subject of pulley trains. The problems in belting require only the application of formulas.

Lesson No. 20.—The micrometer gives an opportunity for practice in handling decimals.

PART 2 STUDENT'S INSTRUCTION SHEETS

GENERAL DIRECTIONS TO THE STUDENTS

The careful mechanic always keeps his tools in good order. Not only should the tools themselves be kept in good condition but they should also be put away in orderly fashion so that they can be found when needed. The machinist should learn to keep his ideas in the same way.

The making of mathematical calculations affords an excellent opportunity for clear thinking. To form the habit of keeping his ideas in order, the student is urged to have a systematic way of making his calculations. Do not figure all over the paper, but always have your work arranged neatly and not occupying too much space. Proceed step by step, arranging the work in columns. Label all partial results and indicate the answer clearly at the end of the problem. Keep the work that you do and write out each finished problem with ink in a notebook.

Do not be discouraged if you happen to forget how to make some calculation. Look it up in the book as often as you need to. The only way to become thoroughly familiar with any process is by repetition.

In the trade the machinist who can make his own calculations does not have to depend on the foreman or superintendent.

Lesson No. 1.—Calculation of stock

The object of this lesson is to give the student practice in making calculations for length of stock, length of cuts, and similar problems which arise in machine-shop work, where the dimensions are given in fractions or mixed numbers.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 4 to 7; sections 5, 6, 7, 8, and 9.

Problems to be done by student.—Page 5, problem No. 7; page 6, problem No. 8; page 11, problem No. 4; page 13, problem No. 15; page 7, problem No. 9; page 7, problem No. 10; and page 13, problem No. 18.

Problems for further study and practice.—Burnham: Mathematics for Machinists, page 12, problem No. 13; page 6, problem No. 5; and page 12, problem No. 8.

Lesson No. 2.—Calculation of stock

The object of this lesson is to give the student practice in making calculations for quantity of stock, where measurements are stated in common fractions or mixed numbers.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 8 to 11; sections 10, 11, 12, 13, and 14.

Problems to be done by student.—Page 9, problem No. 3; page 9, problem No. 4; page 11, problem No. 3 (bottom); page 12 problem No. 12; page 13, problem No. 17; page 11 problem No. 2 (bottom); page 13, problem No. 20; page 13, problem No. 16; page 13, problem No. 14; page 12, problem No. 10.

Problems for further study and practice.—Colvin: Machine Shop Calculations, page 7, problems Nos. 1, 2, 3, 4, 5, and 6.

Lesson No. 3.—Calculation of stock

The machinist is frequently called upon to make measurements and calculations in thousandths of inches; also to change fractional measurements to equivalent decimal readings (such as $\frac{5}{8}$ to 0.625). The object of this lesson is to give practice in conversion of common fractions to decimals and vice versa; also to give practice in calculations involving the use of decimals.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 14 to 19; sections 15, 16 (a) (b), 17, 18, 19, and 20.

Problems to be done by student.—Page 15, problem No. 3 (top); page 15, problem No. 5 (top); page 15, problem No. 1 (bottom); page 15, problem No. 2 (bottom); page 16, problem No. 3 (bottom); page 16, problem No. 6 (bottom); page 16, problem No. 7 (bottom); page 17, problem No. 7; page 18, problem No. 1; page 19, problem No. 7; page 19, problem No. 8; page 20, problem No. 4.

Problems for further study and practice.—Burnham: Mathematics for Machinists, page 21, problem No. 17; page 20, problem No. 13.

Colvin: Machine Shop Calculations, page 15, problems Nos. 1, 2, 3, 4, and 5.

Lesson No. 4.—Laying out work; centering

This lesson is intended to bring out a few simple constructions that are of value to the machinist in laying out work.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 64 to 66; sections 51, 52, 53, 54; pages 68 to 69; sections 56, 57, cases 1 and 2; pages 84 to 85; section 65.

Problems to be done by the student.—Page 65, problem No. 1; page 65, problem No. 2; page 70, problem No. 2; page 71, problem No. 3; page 71, problem No. 4.

Get a piece of broom handle sawed to about 6 inches in length and find the center of each end.

Draw a circle with a radius of $1\frac{1}{4}$ inches and divide the circumference into six equal parts. Draw a triangle in the circle by connecting alternate points on the circumference.

Find the middle point of one side of the triangle drawn in the circle in the preceding problem.

Draw a circle $2\frac{1}{2}$ inches in diameter and divide the circumference into four equal parts. Draw a square in the circle by using the points marked on the circumference.

Draw a straight line 3 inches long. At the end of the line erect a perpendicular 3 inches long. With the meeting point of the perpendicular and the straight line as a center, draw an arc of $1\frac{3}{4}$ inches radius cutting both lines. Find the center of the arc thus made.

Construct a rectangle 3 inches long and $1\frac{1}{2}$ inches wide. Find the center of the rectangle by the meeting point of the diagonals.

Given a circle $3\frac{1}{2}$ inches in diameter, draw any two chords and find the center of the circle by drawing perpendiculars to the chords.

Lesson No. 5.—Cutting speed

The efficiency of the work done by a machinist depends to a great extent upon having cutting tools do their work at proper speed. Speed that is too high injures the cutting edge of the tool or strains the machine; while speed that is too low wastes valuable time. This lesson is intended to show how the actual speed of machining work may be calculated.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 86 to 87, sections 66, 67, 68.

Problems to be done by the student.—Page 88, problem No. 1; page 88, problem No. 2; page 88, problem No. 3; page 88, problem No. 4; page 88, problem No. 5; page 95, problem No. 2 (bottom); page 95, problem No. 3 (bottom); page 96, problem No. 9; page 96, problem No. 11.

Problems for further study and practice.—Burnham: Mathematics for Machinists, page 95, problem 4; page 96, problem 10; page 96, problem 16; page 96, problem 17.

Lesson No. 6.—Cutting feed—Time for cuts

On old-fashioned lathes, with belt and cone pulley on the feed rod, there was not much choice in the matter of feeds. Modern lathes, especially those equipped with quick-change gears, provide for a greater variety of feeds. This lesson is intended to show how feeds may be calculated, and how long it ought to take to make a given cut when the speed and feed are known.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 88 to 89, sections 69 and 70.

Problems to be done by the student.—Page 90, problem No. 1; page 90, problem No. 2; page 90, problem No. 3; page 90, problem No. 4; page 90, problem No. 5; page 96, problem No. 12; and page 96, problem No. 13.

Problems for further study and practice.—Colvin: Machine Shop Calculations, page 73, problems 1, 2, 3, and 4.

Lesson No. 7.—Tapers

The average machinist knows tapers by name or number only. He machines them according to sample or by the cut and try method. This lesson attempts to point out some of the characteristics of the tapers in common use.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 90 to 92, sections 71 and 72.

Problems to be done by the student.—Page 94, problem No. 2; page 94, problem No. 3; page 94, problem No. 4; page 95, problem No. 6 (top); page 95, problem No. 7 (top); page 95, problem No. 5 (bottom); page 95, problem No. 6 (bottom); page 95, problem No. 7 (bottom); page 96, problem No. 8; page 96, problem No. 14; page 96, problem No. 15; and page 97, problem No. 20.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 141, problem No. 2; page 142, problem No. 6; page 142, problem No. 7; page 143, problem No. 8; and page 146, problem No. 18.

Lesson No. 8.—Taper turning

The method of turning a taper by offsetting the tailstock of the lathe is considered in this lesson. This method is the one most commonly used in shop practice. The student should be careful to note that the calculation for offset is always made on the *entire length of the piece between centers*, without regard to the actual length of the taper itself.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 92 to 94, section 73.

Problems to be done by the student.—Page 94, problem No. 1; page 95, problem No. 5 (top); page 95, problem No. 8 (top).

The Sellers taper is $\frac{3}{4}$ inch per foot. How much should the tailstock be set-over for cutting this taper on a piece of work 16 inches long?

Find the set-over of the tailstock for a No. 1 Morse taper (0.6 inch per foot) on a piece of work 14 inches long.

The American taper is $\frac{1}{16}$ inch per foot. Calculate the amount of offset of the tailstock for a taper $3\frac{1}{2}$ inches long on a piece of work whose total length is 8 inches.

Page 97, problem No. 18; page 97, problem No. 19.

A piece of stock, measuring 9 inches over all, is tapered for a distance of 4 inches. The large end of the taper is $2\frac{1}{4}$ inches in diameter, and the small end is $2\frac{1}{2}$ inches. Find the taper per inch and the amount of set-over used in turning the taper.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 143, problem 10; page 144, problem 12; page 144, problem 13; page 146, problem 21.

Lesson No. 9.—Compound rest—Angles; bevel protractors

Short tapers and angles are sometimes cut by using the compound rest on the lathe. The machinist's bevel protractor is used to test the taper or angle. The object of this lesson is to give practice in the calculation of angles and the setting of the bevel protractor. The student should have a bevel protractor.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Page 94, section 73 (2); page 67, section 55; pages 56 to 61, sections 45, 47, 48, 49 (a) (b).

Problems to be done by student.—Page 68, problem No. 1; page 68, problem No. 2; page 68, problem No. 3; page 68, problem No. 4; page 68, problem No. 5; page 71, problem No. 5; page 71, problem No. 7; page 71, problem No. 9; page 62, problem No. 1; page 62, problem No. 2; page 62, problem No. 3; page 62, problem No. 4; page 62, problem No. 5.

Problems for further study and practice.—Colvin: Machine Shop Calculations. Study pages 68 and 69; page 71, problem 4.

Lesson No. 10.—Square root

In order to understand thread calculations the machinist must have some knowledge of square root. This lesson deals with the process of finding the square root of a number.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 73 to 75, sections 60, 61.

Problems to be done by student.—Page 76, problem No. 1; page 76, problem No. 2; page 76, problem No. 3; page 76, problem No. 4; page 76, problem No. 5; page 76, problem No. 6; page 76, problem No. 7; page 76, problem No. 8.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 47, problem No. 14; page 48, problem No. 23; page 48, problem No. 25; page 48, problem No. 30.

Lesson No. 11.—Right-angle triangle

A number of problems in laying out work call for a knowledge of the simple mathematical relations of the sides of the right-angled triangle. The machinist should know how to apply the rule that: "The square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides." The aim of this lesson is to show some applications of the above rule.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 80 to 82, sections 63 and 64.

Problems to be done by student.—Page 81, problem No. 1; page 81, problem No. 2; page 81, problem No. 3; page 81, problem No. 4; page 81, problem No. 5; page 82, problem No. 9; page 83, problem No. 10; page 83, problem No. 15.

Measure the length and width of the top of a rectangular table and calculate the length of the diagonal.

Draw a square measuring 4 inches on a side, calculate the length of its diagonal, and verify your result by measuring the diagonal.

Problems for further study and practice.—Measure the diagonal of some square object and see if you can calculate the length of its side.

Draw an equal-sided triangle measuring 3 inches on each side. Divide it into two right triangles by drawing a line from the middle of the base to the vertex. Calculate the length of the line thus drawn.

Lesson No. 12.—Sharp or V thread

The V thread is mostly theoretical, although what is called a V thread is used on small sizes of screws in the machine shop. As this thread is cut at an angle of 60° , it serves as a basis of the calculations used on other threads. The calculations in this lesson have to do mainly with the depth and root diameter of V threads.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 98 to 102, sections 74, 75.

Problems to be done by student.—Page 103, problem No. 1; page 103, problem No. 2; page 103, problem No. 3; page 103, problem No. 5; page 103, problem No. 6; page 103, problem No. 7; page 110, problem No. 1; page 110, problem No. 2; page 111, problem No. 18; page 111, problem No. 19.

Problems for further study and practice.—Colvin: Machine Shop Calculations, page 61, problems 1, 2, and 3.

Find the single depth, double depth, and root diameter of the following V threads: Eight threads per inch, 9 threads per inch, 10 threads per inch, 14 threads per inch, 18 threads per inch.

Lesson No. 13.—United States standard thread

This thread is the one most commonly used in machine work. It is cut at the same angle as the V thread, but is made flat at the top and bottom. The student should avoid the common error of thinking that one-eighth of an inch is taken from the depth of the thread instead of one-eighth of the depth of the thread itself.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 103 to 104, section 76.

Problems to be done by student.—Page 105, problem No. 1; page 105, problem No. 2; page 110, problem No. 5; page 105, problem No. 3; page 105, problem No. 4.

The root diameter of a United States standard thread of $\frac{1}{8}$ -inch pitch is 0.7307 inch. What is the outside diameter of the thread?

The root diameter of a United States standard thread of 11 threads per inch is 0.5695 inch. What is the outside diameter of the thread?

A $\frac{11}{16}$ -inch tap with United States standard thread has 9 threads per inch. Find the root diameter of the thread.

If the single depth of a United States standard thread is 0.1299 inch, what is the pitch of the thread?

If the double depth of a United States standard thread is 0.7216 inch, what is the pitch of the thread?

Problems for further study and practice.—Colvin: Machine Shop Calculations, page 55: Make the calculations for any five threads of different pitch given in the table and compare your results with those in the table.

Lesson No. 14.—Calculation of drill sizes for taps

The root diameter of a thread is practically the same size as the hole to be bored for tapping the thread. In practice a drill slightly larger than the calculated size is used. The student should always check the results of his calculations with the sizes given in drill tables. These tables can be found in any machinist's handbook.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Page 104, section 77; page 102, section 76 (4).

Problems to be done by student.—Page 105, problem No. 5; page 105, problem No. 6; page 110, problem No. 8; page 111, problem No. 17; page 110, problem No. 7.

Calculate the size of drill to be used for a $\frac{5}{16}$ -inch V tap, 18 threads per inch.

Calculate the size of drill to be used for a $\frac{3}{8}$ -inch V tap, 16 threads per inch.

Find the size of drill to be used for a $\frac{11}{16}$ -inch United States standard tap, 11 threads per inch.

Find the size of drill to be used for a $\frac{7}{8}$ -inch United States standard tap, 9 threads per inch.

Calculate the size of drill to be used for a $1\frac{1}{2}$ -inch United States standard tap, 6 threads per inch.

Problems for further study and practice.—Colvin: Machine-Shop Calculations, page 64, problems 1, 2, 3, 4, and 5.

Lesson No. 15.—Square thread; acme thread; Brown & Sharpe worm thread

With the exception of the square thread, for which there is no definite standard of pitch, the calculation of sizes of the parts of threads given in this lesson is made by formula. The student should become familiar with this form of calculation which is so often used in the handbooks of the trade.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 105 to 110, sections 78, 79, 81, and 82.

Problems to be done by student.—Page 107, problem No. 1; page 107, problem No. 2; page 110, problem No. 6; page 110, problem No. 10; page 111, problem No. 11; page 111, problem No. 13; page 111, problem No. 14; page 111, problem No. 16.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 249, problem 1; page 249, problem 2; page 249, problem 4; page 249, problem 5; page 249, problem 6; page 250, section 203, problem 1.

Lesson No. 16.—Change gears for thread cutting (simple)

The student should be careful to note that the pitch on the "lead" screw of the lathe does not always indicate the lead of the machine. In making calculations the student should always label "stud" and "screw" gears in each problem in order to avoid confusion. Use the sizes of gears that are likely to be furnished with each lathe.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 112 to 115, sections 83, 84, 85, 86, and 87.

Problems to be done by student.—Page 118, problem No. 1; page 118, problem No. 2; page 118, problem No. 3; page 118, problem No. 7; page 123, problem No. 1 (bottom); page 123, problem No. 3 (bottom); page 124, problem No. 15.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 262, problem No. 3; page 262, problem No. 4; page 263, problem No. 1; page 263, problem No. 2; page 263, problem No. 3; page 263, problem No. 4.

Colvin: Machine-Shop Calculations, page 52, problem No. 1; page 52, problem No. 2; page 52, problem No. 3; page 52, problem No. 4.

Lesson No. 17.—Change gears for thread cutting (compounding)

The machinist is sometimes puzzled when he observes that on some lathes the gears listed as stud and screw for cutting 24 threads are the same as those for cutting 12 threads. In the case of the 24 threads the gears are compounded. This lesson is given to show the use of the compound (usually 2 to 1).

Textbooks.—Burnham: Mathematics for Machinists.

Study.—Pages 116 to 117, sections 88, 89.

Problems to be done by student.—Page 118, problem No. 4; page 118, problem No. 5; page 123, problem No. 8; page 123, problem No. 9.

Suppose that a lathe has a gear progression of 4 and a "lead" of 6. The smallest gear on the lathe is 24 and the largest 96. Fill out the following table for cutting the threads indicated by compounding, using as few gears as possible.

COMPOUND		
Thread	Stud	Screw
20	?	?
22	?	?
24	?	?
26	?	?
28	?	?
30	?	?
32	?	?
36	?	?

Lesson No. 18.—Ratio and proportion—Gear trains

In order to solve problems in gear trains the student must have some knowledge of ratio and proportion. A proper understanding of this useful process of arithmetic will furnish the student with the means of solving many problems that arise in trade practice.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 146 to 150, sections 112 to 113.

Problems to be done by student.—Page 151, problem No. 1; page 151, problem No. 2; page 151, problem No. 3; page 151, problem No. 4; page 151, problem No. 5; page 151, problem No. 6; page 152, problem No. 8; page 156, problem No. 1 (bottom); page 156, problem No. 2 (bottom); page 156, problem No. 3 (bottom); page 157, problem No. 17; page 157, problem No. 19.

Problems for further study and practice.—Colvin: Machine-Shop Calculations, page 25, problem No. 1; page 25, problem No. 2; page 36, problem No. 1; page 36, problem No. 2; page 36, problem No. 3.

Lesson No. 19.—Pulley trains; belting

Calculations for pulley trains are essentially the same as those for gear trains. Instead of using the number of teeth on a gear as in gear calculations, the diameter of a pulley is used. Since the pulleys are connected by belts, there is some slipping and the results are not as accurately figured as for gears. There is an added problem in calculating lengths of belts.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 150 to 154, sections 114, 115; page 152, problem No. 7; page 156, problem No. 6 (bottom); page 156, problem No. 3 (top); page 157, problem No. 18; page 156, problem No. 1 (top); page 156, problem No. 2 (top); page 156, problem No. 5 (bottom); page 157, problem No. 8.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 283, problem No. 2; page 281, problem No. 8; page 283, problem No. 3.

Colvin: Machine-Shop Calculations, page 32, problem No. 1; page 32, problem No. 2; page 33, problem No. 1.

Lesson No. 20.—Micrometer caliper

The use of the micrometer caliper involves a certain amount of mathematical calculation. While the student is concerned mainly with the manipulation of the instrument in taking measurements, he should understand its construction thoroughly and should study the mathematical relation between its parts.

Textbook.—Burnham: Mathematics for Machinists.

Study.—Pages 44 to 46, sections 37, 38.

Problems to be done by student.—Page 46, problem No. 1; page 46, problem No. 2; page 46, problem No. 3; page 46, problem No. 4; page 46, problem No. 5; page 46, problem No. 6; page 46, problem No. 7; page 47, problem No. 8; page 47, problem No. 9; page 47, problem No. 10.

Problems for further study and practice.—Marsh: Industrial Mathematics, page 125, problem No. 7; page 125, problem No. 8; page 125, problem No. 9; page 125, problem No. 10; page 125, problem No. 11.

Rehabilitation monograph. Joint Series No. 22.

Unit Course—Penmanship III

FOR MEN WITH COMMON SCHOOL EDUCATION

February, 1919—Trial edition

TEACHER'S MANUAL

QUALIFICATIONS OF STUDENTS

This course is prepared for use with those men who have completed the seventh or eighth grade work in elementary school.

It is expected that this course will appeal to those men who desire to improve their handwriting for distinct business or social purposes.

AIMS OF COURSE FOR STUDENTS

This course provides such training in penmanship exercises as will specialize on the improvement of the ordinary man's handwriting. This improvement will center around the development of legibility, speed, and beauty of form.

These exercises have been worked out carefully in several of the standard courses in muscular movement penmanship. This course will not attempt to provide any duplication of this material. This course does provide a tentative and suggestive outline of exercises selected from these texts on the basis of meeting the conditions of severe time limitations in the schools for the disabled soldiers.

TIME REQUIREMENTS

Forty minutes is the maximum time which any student may profitably spend on one assignment. The course is divided into 30 assignments, thus totaling 20 hours of study and directed practice. Obviously variations can be made in this time schedule to fit individual needs.

EQUIPMENT

Ruled paper, base lines only; medium pen points; large blackboard.

References are made in each assignment to three penmanship manuals. The instructor should review each of these cases fully and decide which manual is best adapted to the abilities and needs of the individual student. One of the following manuals must be selected for the student:

1. Palmer Writing System, A. N. Palmer Co., New York.
2. Business Penmanship, Mills-American Book Co.
3. Kirby Rhythmic Method, J. A. Kirby, Newson & Co.

SUGGESTIONS TO TEACHERS

The fundamental principles of muscular movement writing apply in each of the three penmanship manuals which are recommended in this course. The special applications of these principles for each method are clearly and definitely stated in the teachers' suggestions outlined in the preface of each book. The instructor must study these suggestions carefully. The teaching of muscular movement penmanship is largely dependent on the choice of devices which the instructor uses in the actual teaching work.

The instructor must determine the special needs of the individual student by general testing exercises during the first two or three assignments. In certain instances the student will have had some training in muscular movement exercises. No time should be wasted on the elementary movement drill exercises with this man. He will need some review work, of course, but the instructor must guard against losing his interest during the early part of the course by an overinsistence on work with which he is familiar and experienced.

Board work is especially helpful in the first work on movement exercises and in later work in which special study of certain technicalities in the formation of a letter is required. It is not, however, indispensable. It can be dispensed with if conditions make it convenient. It also has merit as a rest exercise to break long periods of desk practice. Blackboard work should be decreased whenever it ceases to function in improvement.

An excellent opportunity for the use of the standard scales for measuring a student's ability and progress is offered in the work of this course. The Ayres Gettysburg scale and the Thorndike scale afford a variety of grades of penmanship which can be used in measuring any student's ability. A test with one of these scales should be given in the first assignment. Tests may be repeated to excellent advantage in assignments 5, 10, 15, 20, 25, 30. The joint use of the scale by instructor and student provides excellent help for maintaining interest and assures definite knowledge of progress.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

Upon completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

STANDARDS

A student should be able to write a specimen which will measure up to the following:

Grade 16.—Thorndike scale.

Grade 90.—Ayres Gettysburg scale.

STUDENT'S INSTRUCTION SHEETS

Assignment 1

BOARD WORK

Four-inch compact ovals. (NOTE.—Train for light free line first and uniformity later.)

TABLE WORK

Position, feet, back, arms, wrist, hand. (NOTE.—See teacher's helps in each manual for specific instructions and models for correct position.) Show the student by actual demonstration why good position is so vitally important for correct writing, and how bad position does not allow the writer to do his work. The instructor should train the student intensively in the right habit of correct position during the work of the first five assignments. The student will do his best work only when position is taken and held unconsciously as a habit.

Each manual provides the instructor with suggestions for developing looseness and freedom in the student's writing hand. Use these exercises whenever necessary. Do not overemphasize their importance with any student who naturally assumes a relaxed free writing position. Many devices which are effective in training a class of children or young people have no place in the work of individual instruction with an adult man.

Mills: Pages 5 and 6.

Palmer: Drills 1 and 3.

Kirby: Page 1.

Assignment 2

BOARD WORK

Four-inch compact ovals. Train for free light line. Train for uniformity. Count for proper speed.

TABLE WORK

Position: See note under assignment 1.

Mills: Page 7.

Palmer: Drills 7, 8, 9, and 10.

Kirby: Page 2.

Test and measure specimen of student's handwriting with one of the three scales recommended.

Assignment 3

BOARD WORK

Four-inch compact ovals. Train for free movement. Train for uniform size. Train for slant. Train for speed.

TABLE WORK

Position: (See note under assignment 1.)

Mills: Page 9.

Palmer: Drills 11, 12, 13, and 14.

Kirby: Page 4.

Drill on special difficulties in correct formation of capital letters in student's signature.

Assignment 4

BOARD WORK

Four-inch compact lines. Train for free movement.

TABLE WORK

Position: (See note under assignment 1.)

Mills: Page 10.

Palmer.

Kirby.

Assignment 5

BOARD WORK

Four-inch compact lines. Train for light line. Train for uniform size. Train for correct slant. Train for correct speed.

TABLE WORK

Position: Work for improvement in free control of hand based on right position.

Mills: Page 11.

Palmer: Drills 15, 17, 19.

Kirby: Review, pages 1 to 4.

Assignment 6

BOARD WORK

Two-inch compact ovals. (Copy instructor's model.)

TABLE WORK

Position.

Mills: Page 12.

Palmer: Drills 5, 6, 21, 113.

Kirby: Page 5.

Assignment 7

BOARD WORK

Two-inch compact ovals. (Train for uniformity in size and slant.)

TABLE WORK

Copy instructor's model of student's name and present address; insist on arm movement while writing this even at the sacrifice of form.

Mills: Page 3.

Palmer: Drills 28, 29, 31, 32.

Kirby: Page 6.

Assignment 8

BOARD WORK

Two-inch compact lines. (Copy instructor's model.)

TABLE WORK

Practice on signature and address written with arm movement.

Mills: Page 16

Palmer: Drills 33, 34, 36, 116.

Kirby: Pages 7 and 8.

Assignment 9

BOARD WORK

Two-inch compact lines. (Train for uniformity in size and slant.)

TABLE WORK

Copy instructor's model of the student's name and home address, written with arm movement.

Mills: Page 17.

Palmer: Drills 38, 39, 154, 156.

Kirby: Pages 9 and 10.

Assignment 10

BOARD WORK

Two-inch compact reverse ovals. (Correct from instructor's model.)

TABLE WORK

Drill on signature and home address, written with arm movement.

Mills: Review pages 16 and 17.

Palmer: Drills 40, 42, 43, 44.

Kirby: Pages 11 and 12.

Assignment 11

BOARD WORK

Two-inch compact reverse ovals. (Train for uniformity in size and slant.)

TABLE WORK

Mills: Page 18.

Palmer: Drills 46, 47, 48, 157, 158.

Kirby: Pages 13 and 14.

APPENDIX

Assignment 12

BOARD WORK

Selected exercises to develop free control in the lateral movement. (See "Teacher's Instructions" in penmanship manual.)

TABLE WORK

Mills: Page 19.
Palmer: Drills 51, 52, 53, 161.
Kirby: Pages 15 and 16.

Assignment 13

BOARD WORK

Selected exercises to develop skill in the lateral movement.

TABLE WORK

Mills: Review pages 18 and 19.
Palmer: Drills 54, 55, 56, 128.
Kirby: Pages 17 and 18.
Copy from instructor's model:

"I like the man who faces what he must
With step triumphant and a heart of cheer.
Who fights his daily battle without fear,
Sees his hopes fall, yet keeps unfaltering trust
That God is God, that somehow true and just
His plans work out for mortals."

(NOTE.—The instructor must urge the student to write this verse (or some other) with muscular movement. The aim is movement first and attention to the finer details of letter formation later. The student's copy of this verse should be graded and kept for reference in rating improvement.)

Assignment 14

BOARD WORK

Lateral movement exercises.

TABLE WORK

Mills: Page 20.
Palmer: Drills 57, 58, 59, 60, 127.
Kirby: Pages 19 and 20.
Copy exercise noted in assignment 13.

Assignment 15

BOARD WORK

Lateral movement exercises.

Special study of those letters in signature and address of the student which give the most difficulty.

TABLE WORK

Mills: Page 21.
Palmer: Drills 52, 53, 136, 137.
Kirby: Pages 21, 22
Drill work on exercise noted in assignment 13. Time the student's work, compare results with copy made in assignment 13.

Assignment 16

BOARD WORK

Lateral movement exercises.

Special study of those letters in students' signature and home address which give difficulty.

TABLE WORK

Mills: Page 24.

Palmer: Drills 61, 61, 63, 64, 138, 139.

Kirby: Pages 23, 24, 25, 26.

Practice on exercise noted in assignment 13.

Assignment 17

BOARD WORK

Movement drills as required.

TABLE WORK

Mills: Pages 8, 15.

Palmer: Drills 65, 66, 67, 69.

Kirby: Pages 27, 29, 31, 32.

Practice on exercise noted in assignment 13.

Assignment 18

BOARD WORK

Movement exercises.

Special study of capital letters which the student finds difficult.

TABLE WORK

Mills: Pages 25, 26.

Palmer: Drills 72, 140, 141.

Kirby: Pages 33, 36, 37, 39.

Assignment 19

BOARD WORK

Special study of difficult letters in this assignment.

TABLE WORK

Mills: Page 28.

Palmer: Drills 74, 76, 121, 163.

Kirby: Pages 40, 43, 44.

Assignment 20

BOARD WORK

Special study of correct formation of the three most difficult letters in this assignment.

TABLE WORK

Mills: Pages 30, 31, 58.

Palmer: Drills 77, 78, 79, 80, 81.

Kirby: Pages 45, 46, 47, 48, 49.

Assignment 21

BOARD WORK

Special study of difficult letters.

TABLE WORK

Mills: Pages 32, 33, 59.

Palmer: Drills 82, 83, 84.

Kirby: Pages 51, 52, 53.

Assignment 22

BOARD WORK

Selected exercises to meet special needs of the individual student.

Mills: Pages 34, 35, 36, 60.
 Palmer: Drills 86, 129.
 Kirby: Pages 56, 58, 60, 61.

TABLE WORK

Assignment 23

BOARD WORK

Special exercises as required.

TABLE WORK

Mills: Pages 37, 38.
 Palmer: Drills 88, 89, 91, 93, 94.
 Kirby: Pages 62, 63, 65.

Assignment 24

BOARD WORK

Special exercises as required.

TABLE WORK

Mills: Pages 39, 40, 41, 42.
 Palmer: Drills 95, 96, 164, 165.
 Kirby: Pages 66, 68, 69.

Assignment 25

BOARD WORK

Special exercises as needed.

TABLE WORK

Mills: Pages 45, 62.
 Palmer: Drills 98, 99, 100.
 Kirby: Pages 70, 71, 72, 90.

Assignment 26

BOARD WORK

Special exercises as required.

TABLE WORK

Mills: Pages 46, 66.
 Palmer: Drills 101, 102, 166, 167.
 Kirby: Pages 73, 74, 75, 77.

Assignment 27

BOARD WORK

Special exercises as required.

TABLE WORK

Mills: Pages 48, 67.
 Palmer: Drills 103, 104, 105, 106.
 Kirby: Pages 78, 82, 83.

Assignment 28

BOARD WORK

Selected exercises in movement and letter formation to meet the needs of the individual student as shown in the last five assignments.

TABLE WORK

Mills: Pages 49, 70, 71.
 Palmer: Drills 109, 111.
 Kirby: Pages 84, 85, 86, 90.

Assignment 29

BOARD WORK

Selected exercises as needed.

TABLE WORK

Mills: Pages 53, 65.
 Palmer: Drills 130, 131, 132.
 Kirby: Pages 87, 88, 89.

Assignment 30

TABLE WORK

Mills: Pages 57, 59.
 Palmer: Drills 170, 172.
 Kirby: Page 91.

TEST

The student should be able to write in such form and time as will measure up to the following scales:

1. Thorndike scale, grade 16.
2. Ayres Gettysburg scale, grade 90.

Test his skill, grade his productions and report it in records. First and final ratings will be needed to show his progress. Include such records and convenient samples of students' writing with any criticisms on this course as requested in "Foreword."

Rehabilitation monograph. Joint Series No. 23.

Unit Course—Arithmetic III—Teacher's Manual

VOCATIONAL ARITHMETIC FOR AGRICULTURISTS

February, 1919—Trial edition

1. QUALIFICATIONS OF STUDENTS

This course is prepared for men who have had a common-school education and who are experienced or prospective farmers.

The course presupposes a working knowledge of the fundamental operations. If the instructor finds that a student is hampered in the work of the first assignments on account of his inability to add, subtract, multiply, and divide quickly and accurately, he should give the student a rapid review of the work outlined in Unit Courses, Arithmetic I and II.

2. AIMS OF COURSE FOR STUDENT

This course provides a student with such training in arithmetical calculations applicable to common situations on a general commercial farm of average size as will enable him to compute rapidly and accurately, and to understand readily, the common arithmetical problems which are met in a farm experience.

This course is intended to serve as a model for those unit courses in arithmetic which are to be prepared to meet the special vocational interests of other types of industry.

3. TIME REQUIREMENTS

The course is divided into 15 assignments, each of which may require one hour's work in instruction and directed practice.

The student will be willing to do some work out of class if the instructor reaches his interests, especially in those types of problems which have an intimate correlation with actual farming conditions, in his own home environment. The instructor must see to it that the type problems suggested be adapted to the local special conditions of each man.

The assignment of problems for "out-of-class" work must be carefully selected and so presented as to reach the apperceptive bases of the men who are to work them out.

4. EQUIPMENT

(1) Notebooks (for permanent records of common tables of weights and measures and for type problem work). (2) Textbooks.—I. Thomas, "Rural Arithmetic," American Book Co. II. Vincent, "Vocational Arithmetic," Houghton-Mifflin Co.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

The student should be examined frequently throughout the course with sets of type problems similar in content and degree of difficulty to the examples listed under the assignments which he has completed. At the close of the course a test of 10 problems similar to the following should be given:

- (1) A farm sale totaled \$3,225.00. A clerk was paid \$15.00, an auctioneer received 1% commission and a bonus of \$10.00. How much did the farmer realize from the sale?
- (2) The capacity of a freight car is 36,000 lbs. How many bushels of wheat will it hold and what is its value at \$1.20 per bushel?
- (3) Find the capacity of a cistern 5' x 5' x 12'.
- (4) At 65¢ per ton (50 cu. ft.) how much will it cost to fill a silo 12 ft. in diameter and 20 ft. high?
- (5) Rural Arithmetic, p. 103, example 34.
- (6) Rural Arithmetic, p. 107, example 14.
- (7) Rural Arithmetic, p. 97, example 17.
- (8) An apple orchard has 60 trees and each tree produces $2\frac{1}{4}$ bushels which sell at \$1.00 net. Find the value of the land if this crop yields 20% on the investment.
- (9) Rural Arithmetic, p. 131, example 16.
- (10) Rural Arithmetic, p. 155, example 35.

The final rating for the course should be based on the record of the student's work throughout the course and on the rating which he obtains in this final examination using a percentage basis of rating. The student's final rating is to be expressed as follows:

Excellent.....	90%-100%	Fair.....	70%- 80%
Good.....	80%- 90%	Poor.....	below 70%

STUDENTS' INSTRUCTION SHEETS

These Students' Instruction Sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the Students' Instruction Sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students here may be no objection to using the complete bulletin at one time.

Assignment I

Test the student in short exercises to learn his abilities in adding whole numbers.

The Courtis Standard Practice Tests afford very convenient material for this type of work. These cards can be used to best advantage only when the instructor understands the arrangement, form, and purposes of these cards.

The "Teacher's Manual for use with the Card Envelope Edition," S. A. Courtis, contains full instructions for the proper use of the Standard Practice Tests.

The "Student's Record and Practice Pad" may be used to good advantage with those men who are interested in a formal and technical cumulative record of their progress. This material, however, must be used with discretion, as time limitations in this course exclude any extended work of this type during the period of instruction. The student should be encouraged to use the record in "out-of-class" work.

A practical working review test in the fundamental operations, with standard time requirements for each set of examples, is offered in "Rural Arithmetic," pages 29 to 33.

This material is in such form as to allow for practical measurement of the abilities of most of the students.

Process.—Test for speed and accuracy in addition. (a) Courtis Tests (selected). (b) Rural Arithmetic, pages 29, 30, 31.

Problems.—Farm sales. (a) Rural Arithmetic, pages 46, 47, 48. (b) Vocational Arithmetic, pages 50, 51.

Assignment II

Process.—Tests for speed and accuracy in subtraction. (a) Courtis Tests (selected). (b) Rural Arithmetic, page 31.

Problems.—Measurement of capacities of bin, cornerib, silo. Rural Arithmetic, pages 74, 75, 76, 85.

Assignment III

Process.—Tests for speed and accuracy in multiplication. (a) Courtis Tests (selected). (b) Rural Arithmetic, page 32.

Problems.—Measurement of capacities of tanks, cisterns, haystacks. Rural Arithmetic, pages 78, 79, 80, 81, 82.

Assignment IV

Process.—Tests for speed and accuracy in division. (a) Courtis Tests (selected). (b) Rural Arithmetic, pages 32, 33.

Problems.—Standard rations for horses and milch cows. Rural Arithmetic, pages 86, 87, 89, 90, 91.

Assignment V

Process.—Review work on addition and subtraction of fractions. Rural Arithmetic, pages 9, 10.

Problems.—Business with the bank. (a) Bank accounts. (b) Payment by check. (c) Pass book. (d) Interest. (e) Loans. Rural Arithmetic, pages 175, 176, 177, 178.

Assignment VI

Process.—Review work on multiplication and division of fractions. Rural Arithmetic, page 12.

Problems.—Poultry. (a) Rural Arithmetic, pages 102, 103. (b) Vocational Arithmetic, page 67.

Assignment VII

Process.—Work with denominate numbers. Rural Arithmetic, page 18.

Problems.—Hogs. Rural Arithmetic, pages 105, 106.

Assignment VIII

Process.—Review addition and subtraction of decimals. Rural Arithmetic, page 12.

Problems.—Milk industry. (a) Rural Arithmetic, pages 97, 98. (b) Vocational Arithmetic, page 51.

Assignment IX

Process.—Review four processes with denominate numbers. Rural Arithmetic, pages 18, 19, 20.

Problems.—Fruit growing. Rural Arithmetic, pages 69, 70, 71. Vocational Arithmetic, page 64.

Assignment X

Process.—Review Percentage. Special Attention to the applications of Case I.

Problems.—Labor costs. Rural Arithmetic, pages 51–53.

Assignment XI

Process.—Discount. Rural Arithmetic, page 24.

Problems.—Light, Fuel, Water. Rural Arithmetic, pages 128, 129, 130, 131–135.

Assignment XII

Process.—Review Profit and Loss. Rural Arithmetic, page 25.

Problems.—Building problems. Rural Arithmetic, pages 153, 154, 155, 157, 158.

Assignment XIII

Process.—Review work on Interest. Rural Arithmetic, page 26.

Problems.—Land measurements. Rural Arithmetic, pages 39, 40, 41, 42, 43. Vocational Arithmetic, page 98.

Assignment XIV

Process.—Review work on Ratio. Rural Arithmetic, page 27.

Problems.—Farm machinery. Rural Arithmetic, pages 60, 61. Vocational Arithmetic, page 49.

Assignment XV

Process.—Review work on Proportion. Rural Arithmetic, page 28.

Problems.—General business problems. Rural Arithmetic, pages 172, 173, 180, 181, 182, 184.

Rehabilitation monograph. Joint Series No. 24.

Unit Course—Machine Shop Practice VIII—Inspection of Machine Parts I

INSPECTION OF MACHINE PARTS I FOR MEN WITHOUT MACHINE SHOP EXPERIENCE

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. DESCRIPTION OF QUALIFICATIONS OF STUDENTS FOR WHOM THE COURSE IS INTENDED

This unit course is intended for the student who has been long out of school or has a rather limited amount of education, with no previous experience in machine shop practice but with an interest in things mechanical. Such a man can be taught to understand and use the necessary tools and apply the proper judgment for the inspection of the many small and simple machine parts which do not require a fine degree of exactness, but yet do require rigid inspection.

2. ATTAINMENT OF ADVANTAGE EXPECTED TO BE DERIVED BY THE STUDENT

It is expected that the student who finishes this course will be competent to accept employment as an inspector of machine parts, to perform his work in a satisfactory manner, and to gain a livelihood in a light, clean, and lucrative field. He may advance to a still higher degree of proficiency by taking the succeeding unit courses covering the inspection of machine parts of a more complicated character and requiring a higher degree of exactness in inspection; for example, such tools as jigs, fixtures, and gauges.

The student should be advised to take some of the other unit courses available which are closely related to the work of this course, such as—

Arithmetic (fractions and mensuration).

Blue-Print Reading for Machinists.

Mechanical Drawing for Machinists.

3. LENGTH OF THE COURSE

This course is planned to cover 15 hours of study and practice by the student. A distribution of this time is suggested as follows:

	Hrs.	Min.
Teaching how to read the machinists' steel scale.....	45	
Drill in inches and fractions thereof, including the addition and subtraction (mentally) of such fractions as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{3}{32}$, $\frac{1}{64}$ ----	1	30
Elementary explanation of the mechanical drawing or blue print--		45
Elementary explanation of the simple measuring of tools used in this course.....	1	45
Elementary explanation of the number of threads per inch, their diameter and type.....		45
Lesson sheet—		
No. 1.....		30
No. 2.....		30
No. 3.....		30
No. 4.....		45
No. 5.....		45
No. 6.....		45
No. 7.....	1	
No. 8.....	1	
No. 9.....	1	
No. 10.....	1	
No. 11.....	1	
No. 12.....	1	
	15	

4. EQUIPMENT AND MATERIALS

The following list of equipment is recommended for the work of this course. The number of each kind of tool to be furnished will be determined by the number of students in the class.

	Inches
Steel scale.....	12
Spring calipers.....	5
Try square, with hardened blade.....	6
Combination square, with bevel protractor head.....	12
Lathe indicator.	
Bench centers.	
Plug gauges:	
Plain, sizes $\frac{5}{8}$ and 1.	
Threaded, sizes $\frac{1}{4}$ x 20 U. S. std., $\frac{5}{16}$ x 18 U. S. std., $\frac{3}{8}$ x 16 std. V.	
Ring gauges:	
Plain, sizes $\frac{1}{2}$ std., $\frac{5}{8}$ std., $\frac{3}{4}$ std., $\frac{7}{8}$ std., 1" std.	
Threaded, sizes $\frac{1}{2}$ x 13 U. S. std., $\frac{1}{2}$ x 13 std. V, right and left.	

These tools may be obtained from any dealer in machinists' tools. The student should be advised to provide himself with the first four items mentioned above.

For materials it is desirable to have sets of the models as shown on the students' instruction sheets in Part 2 of this course. If the school has a machine shop these parts can be produced in sufficient quantity to accommodate a class of any size. No doubt many schools with machine shops would be willing to furnish outfits of these models for other schools having no shops at a nominal charge sufficient to cover the cost of materials.

In addition to this list of models the instructor should secure other machine parts, incorporating the same principles, for additional practice by the student. Obsolete or discarded parts can be secured from almost any machine shop, and will serve admirably for this purpose.

As the tools used and limits of exactness allowed cover a great range of commercial products, the parts selected for concrete examples should be of such a nature as to involve a number of principles in one piece; and as the attached drawings are suggestive only, parts of a similar character can be substituted if more easily accessible.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers, under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

For this course the student may be rated on a percentage scale, according to the accuracy in his measurements within his given limits, and the time in accomplishment. These are the two prime factors in commercial practice in machine inspection.

6. REFERENCES FOR STUDY

(1) Machine Shop Primer, by Colvin & Stanley. Published by McGraw-Hill Co. 239 West Thirty-ninth Street, New York. The following topics are well treated in this book: Calipers, page 87; combination square, page 128; indicator, page 111; scale rule, page 130; square (try), page 138; plug and ring gauges, page 105; mandrel, page 117; bevel protractor, page 126.

(2) Smith's Advanced Machine Work. Published by Industrial Education Book Co., Boston. This book provides material of particular value to the student who expects to take advanced courses in this subject.

7. GENERAL SUGGESTIONS FOR CONDUCTING THE WORK

Where general specifications have been omitted it will be found that they have been used and explained in some preceding sheet or lesson. The reason for such omissions is therefore obvious. The references given and the related courses mentioned will be of great assistance to the instructor in this course as well as in the succeeding courses.

In measuring parts for which the drawings give only scale measurements, such as $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, $\frac{1}{32}$, and $\frac{1}{64}$, it is the common practice to get as close as the eye can perceive and in no case to allow an error greater than a half of one sixty-fourth, unless a greater tolerance be specifically allowed.

The presentation of the problem should be along practical lines, as shown by the instruction sheet which accompanies the drawing sheet for each task. When the student is able to add and subtract mentally in inches and to use such fractions as are commonly used by machinists; when he has been instructed in the use of the measuring tools used in this course, and when some elementary facts concerning blue prints or mechanical drawings have been imparted to him, he may then proceed with his practical tasks, beginning with Lesson Sheet No. 1. He should be given sufficient parts and specific information as to the limits of exactness required to enable him to pass or accept the fit and condemn or reject the unfit.

8. LESSON NOTES

(1) *The 12-inch scale and its application.*—This unit course being intended for the student who has been long out of school or has had a rather limited amount of education and with no previous experience in machine-shop practice, it may be necessary to teach him the principles of linear measurement in inches and their fractions. He should first be taught the 12-inch scale, each inch being divided into fractions of $\frac{1}{2}$ inch, $\frac{1}{4}$ inch, $\frac{1}{8}$ inch, $\frac{1}{16}$ inch, $\frac{1}{32}$ inch, $\frac{1}{64}$ inch, which are the common measurements used by the machinist. He should be well drilled in the addition and subtraction of these fractions of an inch, so that he may be able to perform these operations mentally and rapidly.

(2) *The use and application of machinists' fractions.*—Having acquired some knowledge of the scale, he should then be given some small blocks of various sizes, the measurements of which are recorded and which are numbered for reference and convenience in checking the student's work. The sizes of these blocks should include the common fractions of an inch used by the machinist in order to provide the exercises in the addition and subtraction of fractional parts of the inch. Length, width, and thickness of one block can be compared with another and results noted.

(3) *The caliper and diametral measurement.*—The second step might be to introduce and explain the use of the ordinary spring caliper and how to set the same to a desired measurement, having for examples and practice some small cylindrical shaped pieces of various diameters, the same to be numbered and their diameters recorded for the purpose of checking the student's work.

(4) *Introducing the drawing and plug gauge with caliper and scale.*—Select a number of simple machine parts, such as shaft collars which have standard holes in them which will require for their inspection the scale to determine the length, the calipers to measure their diameter, and the standard plug gauge which is here introduced for the first time in one of the most elementary forms. We might at this time also begin to acquaint the student with the reading of mechanical drawings or blue prints, so he should be furnished with a drawing or print of the collars which he is to inspect. He should be taught the necessary refinement of measurements required, which in this case would be the length, diameter and size of hole, the sizes of length and diameter to be closely approximate. The hole, which is standard, therefore, must meet a certain degree of exactness. He should be taught that degree by fineness of feeling in inserting the standard plug in the hole. If the plug does not go in or goes in too tightly the piece is to be rejected; on the other hand, if too loose, it should likewise be rejected. Several collars would be required so that the student might have the experience of passing the fit and rejecting the unfit, comparing the part with the drawing.

The student, being familiar with linear measurements, must consult the drawing for his sizes, also see that the piece meets other specifications called for by the drawing. See that the parts are stamped with the identifying number or symbol, general finish, such as all sharp edges and burrs being removed, and verify the count, as the inspector's count is usually final.

(5) *Demonstrating the use of the ring gauge.*—The next exercise might consist of a number of small round shafts of varying lengths and diameters, together with blue prints or drawings, these parts to be inspected much the same as in the previous lesson. This exercise introduces another type of gauge called the ring gauge, which should go over and along the shaft and have a certain degree of exactness in the manner in which it goes on the shaft. The student must be instructed in the use of the ring gauge so that he may determine what to pass or reject within the limits of his instruction. He should also be taught to watch for general appearance, finish, length of shaft, and other simple specifications required by the drawing, as in No. 3. With a pair of bench centers and indicator he can test the concentricity of shaft, or, in shop parlance, see if shafts run true.

(6) *Demonstrating the use of standard threads and screw-plug gauge.*—As this exercise will include another type of gauge—namely, the thread or screw-plug gauge—together with the plug gauge already used, the student must be taught that a thread is known, first, by its diameter, which is measured across the top and not the bottom of the thread; also by the type or style of thread. Use only the ordinary commercial standards of number of threads and type, such as 1"—8 U. S. Std.; $\frac{3}{4}$ "—10 U. S. Std., etc., meaning 1 inch diameter, 8 threads per inch, United States standard type, etc. Another common type of thread should be called to his attention and used in this exercise, known as the Standard V Thread, and classified in a similar way, namely, 1"—8 Std. V; $\frac{3}{4}$ "—10 Std. V; $\frac{5}{8}$ "—11 Std. V; $\frac{1}{2}$ "—13 Std. V, etc., referring to their diameters, number of threads per inch, and type. This exercise might consist of a number of retaining collars having tapped holes for set screws, these collars to be inspected, as in previous cases, with the addition of inspecting the tapped holes with screw-plug gauges, care being taken to compare the gauge with drawing as to style and number of threads.

(7) *Demonstrating the use of the screw-ring gauge.*—Having taken up the common thread, and having gained some elementary information concerning the same, the threaded stud, screw, or bolt may now be taken up. This will involve the use of another type of gauge, the ring-thread gauge or screw-ring gauge, together with the plain ring gauge.

(8) *Demonstrating the use of right and left hand thread gauges.*—The shouldered shaft and shouldered and threaded stud may be taken up now, and should include some shafts or studs with left-hand as well as right-hand thread. In this case the scale, ring gauge, and ring-thread gauge will be used. The student will be given a step in advancement in reading a blue print, although still of a very elementary nature. The use of fractions of an inch will be involved in the inspection of parts of this nature, as length from shoulder to shoulder must be passed upon as well as diameters of the body and thread, wherein the ring and thread gauges are applied as before.

(9) *Demonstrating the use of the scale, combination square, or scale depth gauge, also the try square.*—Some exercises may now be given in linear measurement in plain surfaces, also pieces with slots in which the depth and location of slots are to be determined, using the scale and scale depth gauge or combination square. The steel try square may be introduced here to see that the ends are square with sides and sides square with each other.

(10) *Using the bevel protractor together with the scale, plug gauge, screw-plug gauge and calipers.*—A number of pulleys may now be taken for an exercise. The student should first be taught some facts about the circle and its subdivision into degrees, minutes, and seconds. Usually the fractions of a degree, such as half or quarter degrees, will be of sufficient refinement.

Explain the bevel protractor which is here used for the first time on work of a simple character, as it is required to determine the angle of crown in pulley. Other instruments used are the standard plug for hole, scale for length of hub and face, spring calipers for diameter of pulley, and thread plug gauge for tapped hole in cases where the pulley requires a set screw.

PART 2. STUDENTS' INSTRUCTION SHEETS

[These Students' Instruction Sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing the Students' Instruction Sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.]

Introduction

INFORMATION AND ABBREVIATIONS COMMON TO ALL THE INCLUDED DRAWINGS

Top of sheet: "Rough size and kind of material," such as $\frac{1\frac{1}{2}}{8}$ inch Rd. (Round) to finish $\frac{7}{8}$ inch. No. 1 O. H. steel, meaning No. 1 (carbon contents) O. H. "Open hearth."

C. R. or B. D. "Cold rolled" or "Bright drawn," no finish required or allowed. "F" or "f," finish all over.

C. L., meaning "Collar list" (common to many machines) and listed under C. L., given number.

Std. L., "Stud list."

P. L., "Pin list."

L. N., machine symbol, usually the initials of machine name, as "Loose nailer," or S. N. S., "Straight needle stitcher."

2586+, or any plus number signifies another piece is assembled to part before being sent to stock room.

NOTE. Parts are stamped with number only. They are ordered under their specific list or symbol.

Lesson I.—Inspection of a build-up block

1. Measure with scale the length $2\frac{3}{8}$ inches.
2. Measure with scale the width and thickness $\frac{3}{4}$ inch.
3. Set combination square to $1\frac{1}{8}$ inches and test length of step.
4. Set combination square to $\frac{1}{4}$ inch and test drop.
5. Try sides for square with bottom, using combination square or steel try-square.
6. See that all sharp edges are removed and parts are stamped with list or identifying number.

EQUIPMENT NECESSARY FOR INSPECTION

12-inch machinist's scale.
12-inch combination square.

Lesson II.—Inspection of a bolt holder

1. Try length with scale $3\frac{1}{2}$ inches.
2. Try width with scale 2 inches.
3. Set combination square to $\frac{5}{8}$ inch and try this depth of slot.

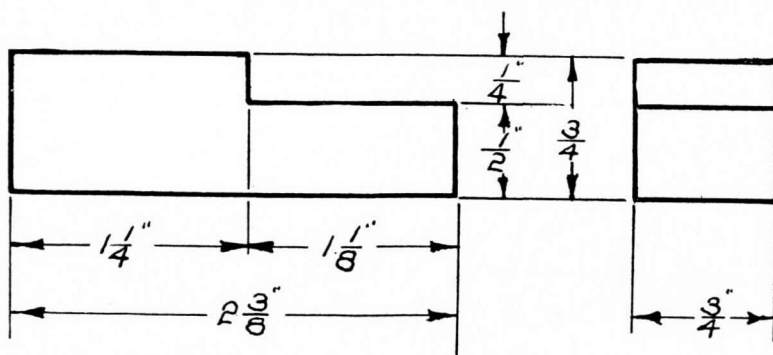


FIG. 1.—Build-up block. No. 1 O. H. steel, $\frac{7}{8}$ -inch Sq "f" all over

4. Set spring calipers to $\frac{3}{8}$ inch and try thickness through bottom of slot.
5. Set spring calipers to $\frac{3}{4}$ inch and try each side of slot to see if slot is central.
6. Test sides with bottom for squareness, using combination square or try square.
7. Test width of slot with $\frac{5}{8}$ -inch plug.
8. See that all sharp edges are removed and parts are stamped with list or identifying number.

EQUIPMENT NECESSARY FOR INSPECTION

12-inch scale.
12-inch combination square.
Spring calipers.
 $\frac{5}{8}$ -inch standard plug.

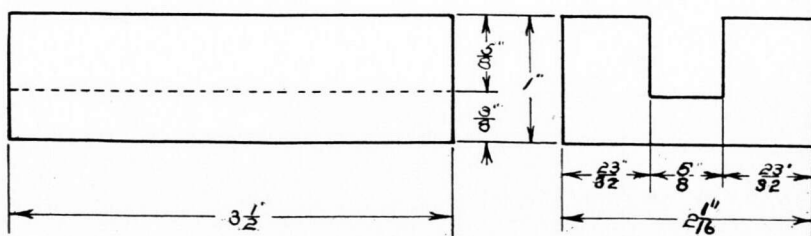


FIG. 2.—Bolt holder. No. 1 O. H. steel, $1\frac{1}{8}$ by $2\frac{1}{8}$ inches "f" all over

Lesson III.—Inspection of a slide gib

1. With scale measure length, width, and thickness.
2. Measure distance between holes "A" measuring from inside edge of one hole to outside edge of other hole which will equal center distance, using scale.
3. Approximate distance of all holes from the edges and ends with scale reading $\frac{3}{8}$ inch, $\frac{1}{2}$ inch, and $\frac{9}{16}$ inch.
4. See if oil hole is approximately $2\frac{3}{16}$ inches from one end (using scale); also see if hole is countersunk to receive and hold oil.
5. See if corners are removed as per drawing and all sharp corners and burrs are removed and parts are stamped with identifying number.

EQUIPMENT NECESSARY FOR INSPECTION

Machinist's scale.

Lesson IV.—Inspection of a collar

1. Try hold with $\frac{5}{8}$ standard plug gauge and have free fit (not loose).
2. Set spring calipers by scale to $1\frac{3}{8}$ inches and test diameter.
3. Set spring calipers by scale to $\frac{9}{16}$ inch and test length.
4. See that sides are square with hole by inserting plug in hole, allowing to extend out of hole, and test with small steel try square.
5. See that all sharp corners are removed and parts are properly stamped with list or identifying number; also see that entrance of tapped hole is countersunk to remove sharp edge.

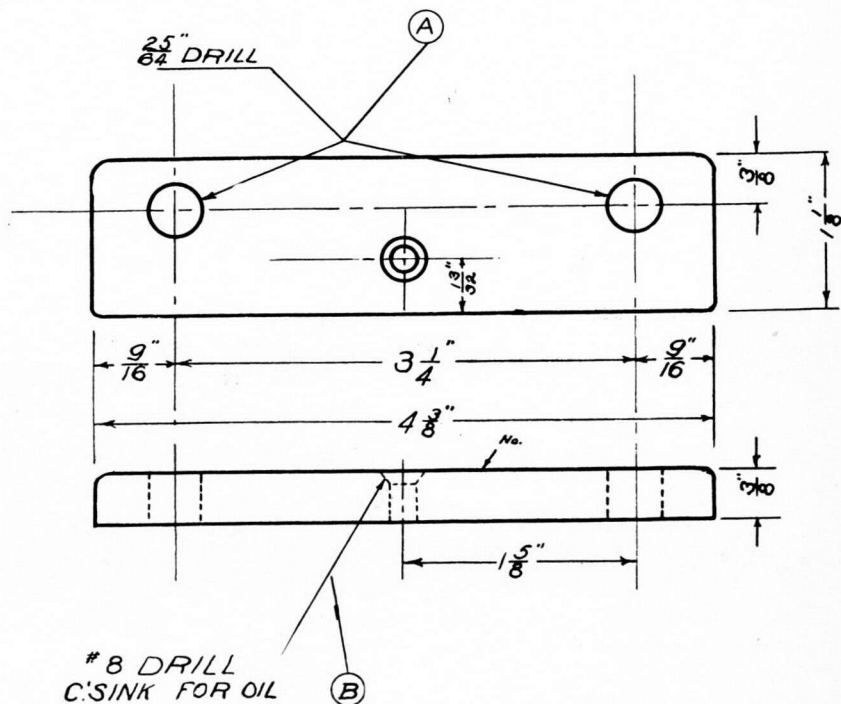


FIG. 3.—Slide gib. Stock $1\frac{1}{2}$ by $\frac{3}{8}$ inches, B. D. No. 1 O. H. steel. Make two

EQUIPMENT NECESSARY FOR INSPECTION

6-inch scale.

$\frac{5}{8}$ -inch standard plug gauge.

Spring calipers.

$1\frac{1}{2}$ -inch steel try square.

Lesson V.—Inspecting a collar with two diameters

1. Try hole with $\frac{3}{32}$ rod or plug, which must go in loose; no fit required.
2. Test tapped hole with $\frac{5}{16}$ inch x 18 United States standard plug thread gauge.
3. Set combination square to $1\frac{1}{4}$ inches and test the length from small end.
4. Set spring calipers to $\frac{7}{8}$ inch and try $\frac{7}{8}$ dimension.
5. Measure to center of hole $\frac{1}{2}$ inch from end (approximate).
6. Note $\frac{3}{32}$ radius on four corner only approximate; also see that all sharp corners and burrs are removed and parts stamped with proper list or identifying number.

EQUIPMENT NECESSARY FOR INSPECTION

6-inch scale.

6-inch combination square.

$\frac{5}{16}$ inch x 18 United States standard thread plug gauge.

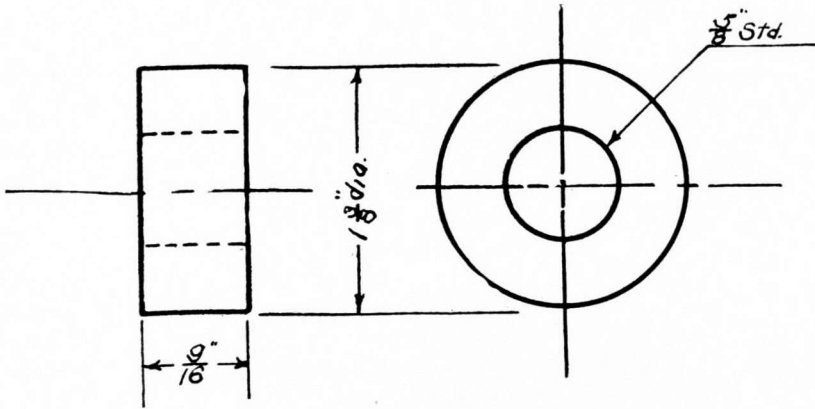


FIG. 4.— $1\frac{3}{8}$ -inch Rd. No. 1 C. R. O. H. steel

Lesson VI.—Inspecting a small collar finished all over

1. See that the number 101 J is stamped clearly on part.
2. Try hole with $\frac{5}{8}$ -inch standard plug gauge, which should fit free, but not so free as to shake. Finish should be smooth.
3. Try diameter with $\frac{7}{8}$ -inch standard ring gauge, collar to push freely through ring gauge without being loose, and should fit the same all of its length, and finish should be smooth.

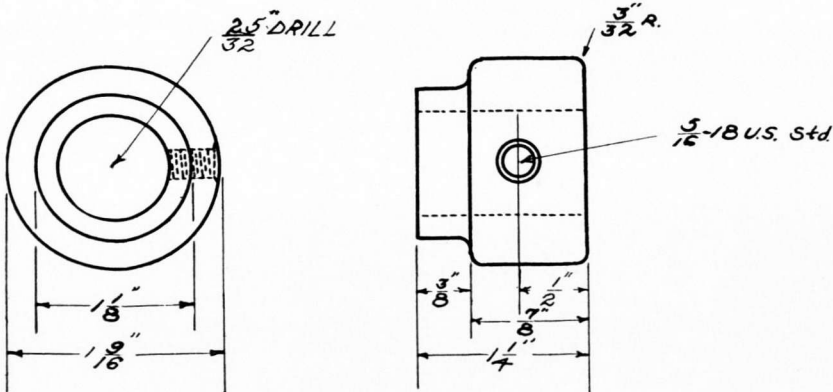


FIG. 5.— $1\frac{3}{8}$ -inch Rd. No. 1 O. H. steel "f" all over

4. Set spring calipers to $\frac{3}{16}$ inch by scale, and test length, feeling lightly and not springing calipers over.
5. Push on lathe mandrel by hand, place on bench centers, and with indicator test for concentricity.
6. See that ends are square with sides, using try-square.
7. Note if one edge around hole is slightly rounded.

EQUIPMENT NECESSARY FOR INSPECTION

$\frac{5}{8}$ -inch standard plug gauge.
 $\frac{7}{8}$ -inch standard ring gauge.
 3-inch or 6-inch scale.
 $1\frac{1}{2}$ -inch or 3-inch try-square.
 Spring calipers.
 Bench centers.
 Lathe mandrel or arbor.
 Lathe indicator.

Slightly round this corner

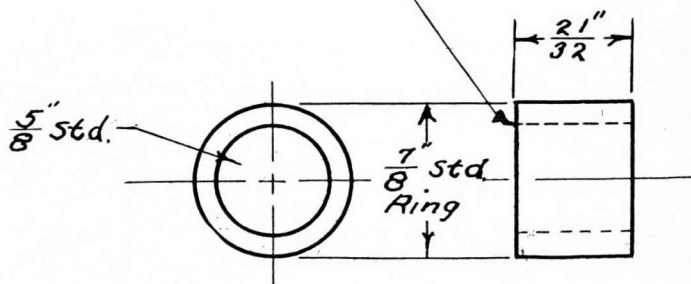


FIG. 6.—C. L.—101 J. Material $\frac{1}{16}$ inch Rd. No. 1 O. H. steel "f" all over

Lesson VII.—Inspection of collar with rounded edges

1. Test hole with $\frac{5}{8}$ -inch standard plug gauge (good fit).
2. Test $\frac{1}{4}$ inch x 20 United States standard tapped hole, with $\frac{1}{4}$ inch x 20 United States standard thread plug gauge.
3. Set spring calipers to 1 inch on scale and try outside diameter.
4. Set spring calipers to $\frac{5}{8}$ inch on scale and try length.
5. See that tapped hole is approximately in center, using scale.

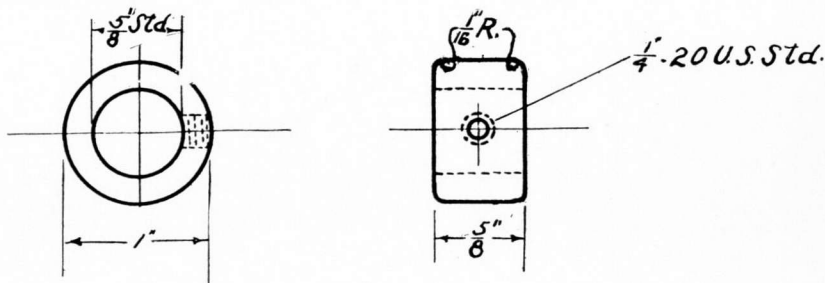


FIG. 7.—C. L.—97 J., 1 inch Rd. B. D. No. 1 O. H. steel

6. See that corners are rounded $\frac{1}{16}$ inch radius, as per drawing (approximately).
7. See that parts are stamped properly with the list or identifying number.

EQUIPMENT NECESSARY FOR INSPECTION

$\frac{5}{8}$ -inch standard plug gauge.
 $\frac{1}{4}$ inch x 20 United States standard thread plug gauge.
 Spring calipers.
 6-inch scale.

Lesson VIII.—Inspection of shipper rod

1. Test diameter "A" with $\frac{1}{2}$ -inch standard ring gauge. (See that gauge goes up to shoulder.)
2. Test thread at "B" with $\frac{1}{2}$ inch x 13 United States standard thread ring gauge.
3. Test length of "A" $1\frac{11}{16}$ inches with scale.
4. Measure length from shoulder "C" to pin "D" ($6\frac{3}{4}$ inches— $\frac{1}{8}$ inch— $6\frac{5}{8}$ inches, obtained by subtracting one-half the diameter of pin).
5. Set combination square to $8\frac{3}{4}$ inches and measure over all. (NOTE.—It will not be necessary to measure the $\frac{11}{16}$ dimension, as it has been taken care of by the other measurements.)
6. See that pin is tight by tapping on hard wooden block.
7. Note if end is beveled, all burrs and sharp corners are removed, and parts properly stamped with list number on end "E."

EQUIPMENT NECESSARY FOR INSPECTION

$\frac{1}{2}$ -inch standard ring gauge.
 $\frac{1}{2}$ x 13 United States standard thread ring gauge.
 12-inch combination square.
 6-inch scale.

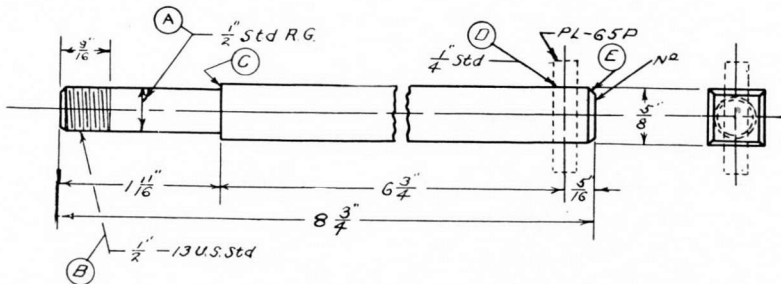


FIG. 8.—Shipper rod. Material $1\frac{1}{4}$ inches square. No. 1 O. H. steel 1 P. L.—65 P.

Lesson IX.—Inspecting a slide guide gib

1. Test holes "A" with $\frac{11}{16}$ -inch rod or plug (to go in free).
2. Scale $1\frac{3}{4}$ -inch distance between holes with scale, measuring from inside edge of hole to outside edge of other hole, which will equal center distance.
3. Measure over all dimension 3 inches with scale.
4. Measure $\frac{5}{8}$ dimension from one end only, as length measurement takes care of the other end.
5. Try width with scale— $\frac{7}{16}$ plus $\frac{11}{16}$ equal $\frac{9}{8}$ or $1\frac{1}{4}$.
6. Measure thickness with scale.
7. Measure $\frac{3}{8}$ -inch distance from edge of bevel to holes (approximately).
8. Set bevel protractor to 45 degrees and test bevel, which should be quite accurate.

EQUIPMENT NECESSARY FOR INSPECTION

$\frac{11}{16}$ -inch rod or plug.
 Bevel protractor.
 6-inch scale.

Lesson X.—Inspection of brake guide rod

1. Test diameter of body with $\frac{1}{2}$ -inch standard ring gauge (to go on but not loose).
2. Test thread with $\frac{1}{2}$ x 13 United States standard thread ring gauge.
3. Measure with scale the $6\frac{1}{4}$ -inch length from head.
4. Measure length of thread 5 inches with scale.
5. Measure length of shoulder $\frac{3}{4}$ inch with scale.

6. Measure thickness of head $\frac{1}{4}$ inch with scale.
7. Set spring calipers to $1\frac{5}{8}$ on scale and test diameter of head.
8. Test $\frac{3}{4}$ diameter with $\frac{3}{4}$ -inch standard ring gauge (to be free).
9. Note that all sharp corners and burrs are removed and parts are properly stamped with list or identifying number.

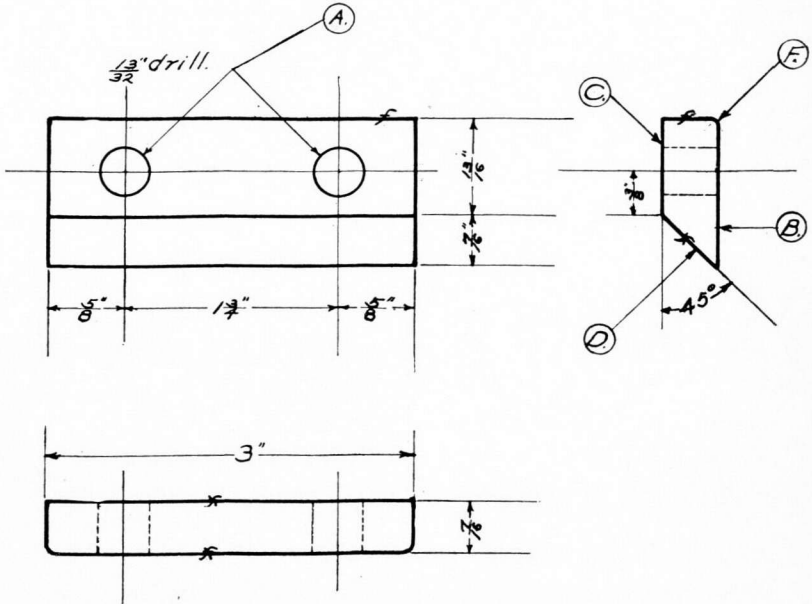


FIG. 9.—Slide guide gib. $1-1\frac{3}{8}$ by $\frac{1}{2}$ inch. No. 1 O. H. steel

EQUIPMENT NECESSARY FOR INSPECTION

- $\frac{1}{2}$ -inch standard ring gauge.
- $\frac{1}{2}$ inch x 13 United States standard thread ring gauge.
- $\frac{3}{4}$ -inch standard ring gauge.
- Spring calipers.
- 12-inch scale.

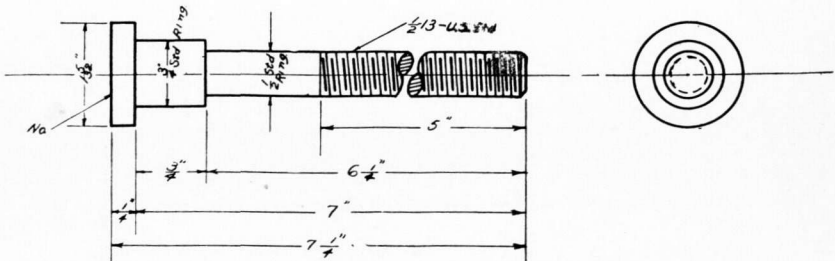


FIG. 10.—Brake guide rod. $1\frac{1}{8}$ -inch Rd. No. 1 O. H. steel

Lesson XI.—Inspection of a shaft pulley

1. Test 1-inch hole with 1-inch standard plug gauge; plug gauge to be a wringing fit.
2. Test tapped hole with $\frac{3}{8}$ -16 standard V thread plug gauge.
3. Set spring calipers to 3 inches on scale and try largest diameter.
4. Set spring calipers to 2 inches on scale and try diameter of hub (tolerance $\frac{1}{16}$ inch).
5. Set spring calipers to $2\frac{5}{16}$ inches on scale and try length over all.

6. Set combination square to $\frac{1}{16}$ inch and test length of hub.
7. Push on 1-inch lathe mandrel or arbor place between bench centers, and with lathe indicator test for concentricity (should run reasonably true).
8. Set bevel protractor at 2 degrees and test angle of crown.
9. Set combination square to $1\frac{3}{8}$ inches and see if tapped hole is approximately in the center.
10. See that the proper list number is stamped thereon and that all sharp edges are removed.

EQUIPMENT NECESSARY FOR INSPECTION

1-inch standard plug gauge.
 $\frac{3}{8}$ inch x 16 standard V thread plug gauge.
 6-inch scale.
 Combination square.
 1-inch lathe mandrel or arbor.
 Bench centers.
 Lathe indicator.
 Bevel protractor.

1- CAST IRON $\frac{1}{8}$ " all over

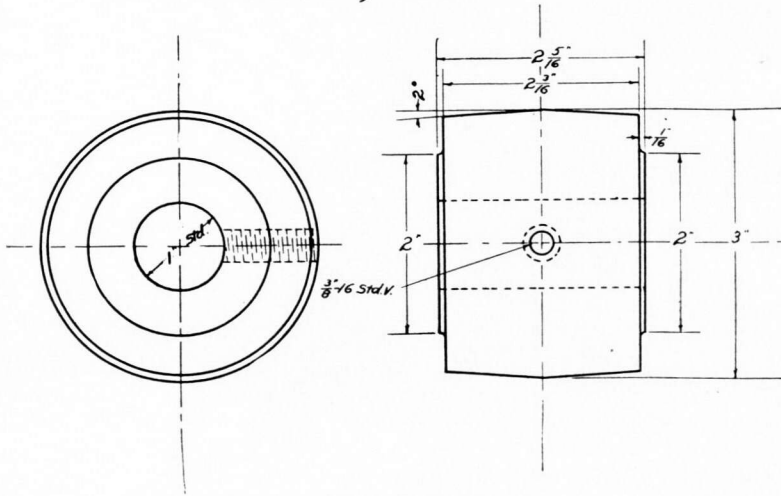


FIG. 11.—Shaft pulley

Lesson XII.—Inspection of a grinder shaft

1. Test thread on one end with $\frac{1}{2}$ -inch x 13 standard thread ring gauge and the other end with $\frac{1}{2}$ -inch x 13 standard thread ring gauge. NOTE: Right-hand thread is always understood if not otherwise specified.
2. Measure length of threads $1\frac{1}{8}$ inch with scale.
3. Measure from ends to shoulders with scale— $1\frac{3}{8}$ plus $\frac{7}{8}$ equals $1\frac{1}{4}$ inches.
4. Test $\frac{1}{2}$ -inch diameters with $\frac{1}{2}$ -inch standard ring gauge.
5. Test $\frac{5}{8}$ -inch diameters with $\frac{5}{8}$ -inch standard ring gauge.
6. Set combination square to $6\frac{1}{2}$ inches and test length from shoulder to shoulder.
7. Set combination square to 3 inches and test from shoulder to set spot ($3\frac{1}{4}$ inches minus $\frac{1}{4}$ equals 3).
8. Set spring calipers on scale to $1\frac{3}{8}$ inch and test thickness through set spot.
9. Place "V" block on surface plate and roll shaft and test for concentricity with lathe indicator, or place between bench center and test for same with lathe indicator.
10. Note if sharp corners and all burrs are removed and parts are properly stamped with identifying number.

EQUIPMENT NECESSARY FOR INSPECTION

$\frac{1}{2}$ -inch x 13 standard V ring gauge.
 $\frac{1}{2}$ -inch x 13 standard V ring gauge, left-hand.
 $\frac{1}{2}$ -inch standard ring gauge.
 12-inch combination square.
 $\frac{5}{8}$ -inch standard ring gauge.
 6-inch scale.
 "V" blocks and surface plate or bench centers.
 Lathe indicator.
 Spring calipers.

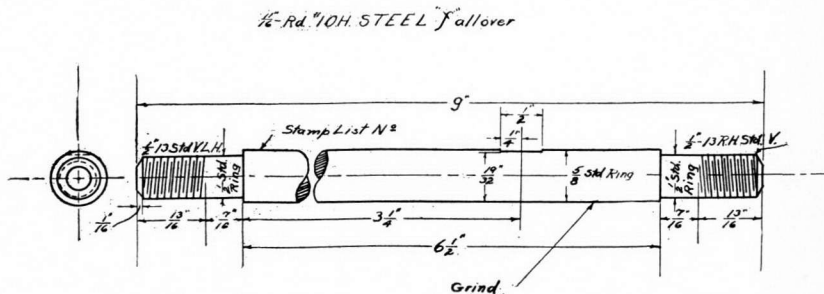


FIG. 12.—Grinder shaft

Rehabilitation monograph. Joint Series No. 25.

SPECIFICATIONS AND PROSPECTUS FOR THE JOINT SERIES OF REHABILITATION COURSES FOR DISABLED SOLDIERS

February, 1919—First edition

Profiting by the experience of European countries, America undertook to provide curative work for the men in the Army hospitals. The primary purpose of such work is to hasten the physical and mental functional restoration of the disabled and sick soldiers.

Curative effects are of two kinds—specific and general. In many cases the activity has a direct therapeutic effect upon the disability. Stiff joints and weakened muscles are made to function by exercise on the typewriter, on treadle and crank machines, by knitting, basket making, carving, weaving, planing, hammering, gardening, etc. Erratic and weak hearts are strengthened and steadied by regulated exercise. In other cases the therapeutic effect is more general, but none the less valuable. The disability is such that exercise can not reach it directly, but the general improvement in physical tone will stimulate all bodily processes and hasten recovery.

The therapeutic effect of any activity depends almost directly upon its appeal to the man, upon the degree to which it enlists the man's interest and effort. To the extent that it engrosses his attention, occupies him completely, and calls forth his best cooperation, it will bring forgetfulness of disabilities, give hope instead of despair, and improve the chances for full functional restoration. In some cases the activity farthest removed from the man's ordinary vocation will present the strongest and most immediate appeal. With most men during the time of greatest weakness, perhaps while still confined to the wards, the activities which are merely diversional, novel, simple, and without exacting standards will present the greatest appeal. Other men will be most interested in things which have an appeal because of their future usefulness. Most men as their strength returns will turn away from the merely momentary diversional occupations to those which have more promise for future usefulness. No man should be allowed to continue in trivial temporary employment when something more useful and likely to call out greater effort can be provided. For most men, then, the things likely to be useful will make the greatest appeal and hence exert the greatest

curative effect. It is this that makes vocational education so valuable an agency in restoring men to full physical and functional activity. The curative workshops, fields, and classrooms exert therapeutic value because they give useful knowledge and skill which appeal to the men as well worth while.

Great variety of activities in unlimited amounts and adapted to peculiar limiting physical conditions are required. To find occupations suitable for men varying not only in physical disability, but in natural equipment, in social, educational, and vocational acquirements is a difficult task. To supply these varied activities in proper quantities educational activities are enlisted. Properly devised, a school can furnish curative diversional and useful activities in great variety, capable of full control and suitable for men of all degrees and conditions.

A factor which greatly increases the future usefulness of educative activities for the disabled man in Army hospitals is the possibility of continuing his education after his discharge under the direction of the Federal Board for Vocational Education. To be able to make real progress toward his vocational education while still in hospital makes a strong appeal to an ambitious man. It is a stimulus for effort, a sure hope of future success which will exert wonderful influence in hastening and improving his chances for recovery. It is the best tonic to cause the man, discouraged by physical disability, lulled into lethargy by unwonted attention and idleness, to "buck up" and determine that he will recover and fight his own fight and ask no odds from charity and benevolence. The hospital school then must plan to become the preparatory department, giving the men full functional restoration and inspiring them with a desire to continue their rehabilitation after discharge with the Federal Board for Vocational Education.

It is evident that an educational agency to meet these conditions will present many variations from conventional instruction. Its limitations are definite and determinative. Its activities must always be so planned and conducted as to exert a curative effect upon each man's disability. To be of greatest curative value it must give greatest appeal, which means it must be of greatest use to each man. This requires that the instruction must take into account the mental, physical, social, educational, and vocational history and future of each man. The men represent quite fairly the young men of the United States. They come from all sections of the country, representing many nationalities, with all varieties of social inheritance, industrial and commercial experience. Whatever is true of American young men everywhere is true of these men. The majority of them have only a limited common-school education. An alarming number can not read and write English. Many can not even speak English, though all have some understanding of oral English. Mental tests show a surprising number of men low in general intelligence. The future of such men present perplexing problems.

Trained vocational teachers are scarce and instructors are often recruited either from craftsmen lacking in training for teaching or from teachers lacking craftsmanship in the vocation. For either of these guidance is needed. These courses aim to be real helps to instructors and by defining, well-planned, expertly selected subject matter give maximum progress to the students within their limitations.

Visualize, if you will, the woodshop instructor who is confronted with a group of men planning to be farmers. The time of each is very limited. The type of farm to which each plans to return may be known. The instructor has for his help three short, elementary unit courses for three common types of farms—poultry, dairy, and general farms. Men can be given instruction in the use of common woodworking tools through some common applications directly bearing upon the chief vocational interest. This increases the appeal to the men with a resulting increase in effort and curative value.

Or consider the instructor in English who has a dozen different short unit courses to fit the needs of prevailing types of men. His students may be non-English-speaking illiterates, non-English-speaking men educated in their native languages, English-speaking illiterates, men with elementary education, or men with higher schooling. English is probably not greatly different for them all, but effective instruction in English will present many variations. The variety of courses offered aims to help the instructor to make suitable adjustments. The same might be said of the series of arithmetic units, each with its vocational setting for its motivating principle.

Such manuals did not exist. They had to be prepared. To prepare them a joint committee from the Surgeon General's Office and the Federal Board for Vocational Education was created. Funds for the expenses of the committee and the collaborators were provided by the Red Cross. The committee operated by engaging experts to assist in their several lines. Each collaborator advised in making the list of unit courses necessary to cover his field. This is called the "break up" in that field. Certain units were then selected by the committee as the first ones to be prepared by the collaborators. It was not planned to prepare all the units listed in any field of instruction but to outline the field by a list of proposed unit courses and use the few that are prepared as samples which with these "Specifications" will serve as guides for anyone interested to prepare the others later. It thus becomes a great cooperative plan which can be extended to cover the entire field of this short-course type of vocational instruction.

To prepare such manuscripts it soon became evident that very definite directions would be needed for the guidance of collaborators. Thus the Specifications were created. Like the builder of a house who is not an architect himself still defines the task for his architect, so the committee set the task for the expert. The expert employs his knowledge in selecting and grouping the matter for instruction and in suggesting the methods.

As the "Specifications" themselves are necessarily in mechanical form it may be well to call attention briefly to some of their distinguishing characteristics. Each unit course states very definitely the type of man for whom it is intended, the length of time that will be required by an average student to complete the course and the goal which he should reach at the completion of the course. There is some danger in thus setting up the target because it makes failure to achieve the purpose of the course more evident. They are in no sense general courses but each is definite and pointed, aimed at some stated target.

The courses are not textbooks or even syllabi, but really manuals referring wherever possible to published texts. Bibliographies are limited purposely to a small critical list of books which the author thinks will best serve the particular purpose of that unit.

Each unit tries to give some knowledge and skill in some specific task. This is not a logical, historical, chronological, or orthodox method in making textbooks. Many short simple courses may include many processes some of which are really quite advanced and no attempt can be made to give more than a smattering of such processes. Each unit aims to fit the man to do something for which there is use in life. If he finishes but one unit he has something complete rather than a fragment of a more ambitious course. It may be but a penny, but it is coin of the realm rather than the promise of a fraction of a dollar, valueless until the whole is earned.

Most courses present distinct student-lesson sheets telling the student in detail the steps he must take in that lesson. The aim is two-fold, to train the student in self help and to relieve the instructor, thus making possible more individual instruction. The nearest analogy to these lesson sheets are the lessons sent out in correspondence instruction. The aim is to make the instructor the advisor and helper of the student when difficulties present themselves.

Each unit aims to provide alternate exercises, supplemental reading etc., for individual adjustment to needs of differing students. In some respects the courses may seem to be mechanically following a rather formal outline but in these opportunities for variation they provide for initiative and play of student and teacher's curative powers.

Whenever they existed, use has been made of practical tests and scales for measuring progress of students. Preference is given to objective standards. To work out standards for the industrial courses is an attractive problem for the users of these manuals. Objective, practical standards will be real contributions to vocational education. Wherever such standards exist and first and final ratings are made it will be interesting to note what adults can accomplish in short intensive training.

The future application of these manuals can only be determined by trial, but many possibilities are apparent. The crippled in industry need rehabilitation as much as disabled soldiers. If the plan proves helpful for one, why not for the other? Adults and adolescents everywhere need vocational training to replace the vanishing apprenticeship. Night schools, continuation classes, short courses everywhere might profitably use these or similar manuals. Perhaps public-school curricula making can profit from some of the lessons that will result from this governmental experiment in education.

OUTLINE OF SPECIFICATIONS

Definition: A unit course of study shall be defined in these specifications as an organized unit of instruction comprising suggestions for teachers and instruction sheets for students.

All unit courses must conform to standards 1 to 8, inclusive.

1. All courses are to be adapted to the needs of disabled soldiers.
2. All material is to be written in short-unit courses.
3. Each unit must be reasonably complete within itself.
4. Each unit must be related to the other units of the course.
5. Each unit should be correlated with agencies of later instruction.
6. Each unit must provide for modification to suit individual needs.
7. Each unit must be adapted to individual instruction rather than class work.
8. Each unit should be divided into definite lessons, jobs, or tasks.

Manuals for instructors must conform to standards 9 to 14, inclusive.

9. Each manual for instructors must provide directions for conducting the work.
10. Each manual must include description of qualifications of student for whom the course is intended.

11. Each manual must state the attainment or advantage expected to be derived by the student.

12. Each manual must state the approximate time required to complete the unit course.

13. Each manual must list the necessary equipment and materials.

14. Each manual should suggest standards for measuring, rating, and recording the work of the student.

Students' instruction sheets must conform to standards 15 to 18.

15. Students' instruction sheets should be provided to be used separately, lesson by lesson.

16. Each lesson sheet must give references for required study, giving book and pages for each lesson, job, or task.

17. Each lesson sheet must give a specific statement of the task, job, problem, or experiment constituting each lesson.

18. Each lesson sheet must provide questions for further study.

SPECIFICATIONS

(Revised December, 1918)

1. *All courses are to be adapted to the needs of disabled soldiers.*—These specifications are all devised for instruction in Army hospitals and in schools approved by the Federal Board for Vocational Education for training disabled soldiers.

Collaborators should confer with the committees of their respective fields for further specific information relating to their special fields.

2. *All materials are to be written in the form of short-unit courses.*—The short-unit plan is fully explained in the following: (1) "Short Unit Courses for Wage Earners," Bulletin No. 159, United States Department of Labor, Bureau of Labor Statistics. (2) "Evening Industrial Schools," Bulletin No. 18, Federal Board for Vocational Education.

3. *Each unit must be reasonably complete within itself.*—The task involved in the instruction of disabled soldiers is to give each man as complete a mastery of the project selected as is possible in his available time. However elemental the project selected may be, it should be a whole rather than a fragment. Each unit course must give the man some usable unit of knowledge or skill. Another reason for requiring that each unit be complete is that each may be printed separately.

4. *Each unit must be related to the other units of the series or group so that the student may pursue cumulatively any other units desirable or possible within his limitations of time or physical condition.*

5. *Each unit should correlate with units that may be offered by agencies of later instruction.*—The Federal Board for Vocational Education has been designated by Congress as the agency to reeducate all soldiers and sailors after their discharge whom the Bureau of War Risk Insurance decides have suffered a disability of 10 per cent or more. Prior to their discharge all sick and disabled men in general hospitals are in charge of the Surgeon General of the United States

Army. In order to insure continuous progress for the men it is necessary that the work before and after discharge should be carefully integrated. It is to effect this that these agencies have cooperated in the preparation of these courses.

6. *Each unit course must provide for modification to suit individual needs.*—The men present every conceivable variation in social and industrial background, in schooling, in mental ability, in physical condition, in needs, aims, and purposes. The course of study must provide for fitting the individual's needs. One device for this will naturally be a supply of alternate exercises, graduated in difficulty so that men of varying ability may still use the same course but vary in the amount and degree of work mastered.

Supplemental reading and suggested projects for individual variation will be helpful. Above all it must be made clear to the instructor that such wealth of material is not for all students, but that he must select the material suitable in degree and amount for each student's need.

7. *Each unit course must be adapted to individual instruction rather than class work.*—Because of the diversity in physical condition, capacity, aims, and attainments of the students instruction must necessarily be on an individual basis. The possibility for class instruction must be left largely to the judgment of each instructor, according to the conditions existing in his particular group.

8. *Each unit course should be divided into definite lessons, jobs, or tasks.*—A "lesson" does not necessarily mean an amount of work to be completed in one session or any definite period of time. The time required for the different jobs or tasks comprising the unit may vary considerably. One lesson might be accomplished in one hour while another might require five hours; also the number of such lessons in a unit will vary with the content of the unit. There might be three lessons or there might be 25.

9. *Manual for instructors.*—This should include general directions or suggestions for conducting work. These should be definite and helpful, applying specifically to the particular unit course. They should be written sufficiently clear and complete to enable the instructor to conduct the work to the best advantage. All parts of the course which might be included in the instructors' manual should be so prepared that they can, if desired, be printed separately from the students' instruction sheets. The manual will also specifically include items 10 to 15 following.

10. *A description of the qualifications of students for whom the course is intended, is necessary with each unit course.*—It is probable that in many subjects several courses will have to be prepared in order to meet differences in student attainments, capacities, time, and purposes. For example, in English, courses in friendly letter writing may be needed for several types of men, such as non-English-speaking men, English-speaking illiterates, men with lower elementary education, men with grammar-grade education, men with secondary education, and perhaps men studying to become teachers of English.

In tractor operation, courses might be made for men with farming experience, and for men without it, for men with gas-engine experience, and for the novice.

In auto mechanics, courses might contain units like the following:

Carburetors, their care and adjustment, for men without experience who wish to become car owners and amateur mechanics.

Carburetors, their care and adjustment, for men with drivers' and amateur mechanics' experience who wish to become garage men.

Carburetors, their care and adjustment and repair, for men with general garage experience who wish to become carburetor specialists.

11. *A statement of the specific aims of the course, or the attainments and advantages to be derived by the student by reason of completing the course is also important.* In some cases this is implied in the title of the unit, as in "lettering for printers"; it is desirable, however, to have this more fully explained in some such form as: "This unit is intended to train the printer to sketch title pages or other display work in such a manner as to show the use of the various forms of letters and the arrangement of mass to the best advantage."

English friendlyletter writing for non-English-speaking men mentioned in No. 10 might have as its purpose: "This course aims to prepare the man to carry on very simple friendly correspondence in English and to acquaint him with helps and manuals for further study and improvement."

12. *Approximate time required to complete the unit course.*—Most of the men for whom these unit courses are intended will not be able to complete long courses. While in the hospitals they will be limited to the period of convalescence and after their discharge from the Army they will desire short, intensive, vocational preparation. The man's circumstances will determine the extent of his instruction. The instructor must advise work for each man such that he can properly complete one or more definite unit courses during the time at his disposal. To enable instructor and student to make proper choices requires that the length of time needed for the completion of each unit be definitely stated. Such statement should be made in total number of hours including instruction, study, recitation, and practice necessary for an average student of the grades for whom the course is prepared. In most courses the topic itself will determine the length. In some subjects such as penmanship the time available for the course may determine the content. The possibilities for cumulative work in several unit courses permits of more extended study by those who can avail themselves of it.

In general, short unit courses are preferable to long ones. From 15 to 30 hours of instruction, study, recitation, and practice will be suitable.

13. *Necessary equipment, materials, and working conditions.*—The teacher of the course and the hospital or school authorities must have a definite statement of the equipment and materials necessary to carry out the work of the unit course. The list should be sufficiently definite and complete to serve as a guide for the school which intends to introduce the course and must secure the necessary equipment and materials.

14. *Standards for rating students.*—Upon the completion of any unit course the student should be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school. It is, therefore, desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

Each subject will require its own peculiar method of testing and rating the achievement of the student. Wherever possible, the standard tests already in common use should be employed. For example, in penmanship, use the Thorndike or Ayres Penmanship Scale. Civil-service tests might be employed for some subjects. In subjects for which no such standard tests are available, the writer of each unit is requested to propose standards of achievement or proficiency to be attained by students, together with methods of rating and recording the students' work.

15. *Students' instruction sheets.*—In most cases separate lesson or instruction sheets for students must be provided. These, if properly planned, will conserve the instructor's time and give the student valuable training. It is desirable that each unit course also include in the introductory section ample directions to students for proceeding with the work. These directions should be written in language within the students' comprehension. It should be borne in mind that a large percentage of the men who will take these courses have never gone beyond the sixth or seventh grades of the elementary schools. All directions to students should therefore be very definite and explicit. Each lesson sheet should specifically include items 16 to 18 following.

16. *References for required study.*—It is the purpose of these courses to utilize existing material as far as it is available. Therefore standard textbooks are preferred where practicable. It is also desirable to acquaint the student with the best sources of information on his specialty and to develop his faculty for self-help and self-culture.

Care should be taken, however, to avoid using too many reference books for any given unit. Two or three of the most available books or bulletins used as basic tests will be better than a larger number.

The reference should contain the specific information necessary for the student to understand and perform the task immediately before him and should give author or title and page, so that he can turn readily to it. For example, "Smith, Modern Gasoline Automobile," pages 117-124.

It is frequently feasible to list the reference books by number rather than to give full name and author and title every time. In this case if the book above mentioned is numbered 3 in the list of reference books, the reference would read: 3:117-124. This means that the student will turn in book No. 3 (Smith, Modern Gasoline Automobile) to pages 117-124 and study the same before proceeding with the practice manual or experimental part of the lesson.

Collaborators in providing reference lists will indicate, in addition to author, titles of books, bulletins, or trade publications, also place and date of publication, publisher, and price, and where desirable a brief statement of the content and particular usefulness of the publication.

17. *Specific statement of the task.*—This should tell the student exactly what to do, with sufficient directions as to how to do it and the results to be expected.

For many of the unit courses contemplated excellent detailed lesson sheets have already been produced by correspondence schools, by extension departments of colleges, and by manufacturers of various lines. Wherever such lessons are found to comply with the specifications herein given, they may be used without attempting to rewrite the material, when not copyrighted, in which case due credit should be given.

References can be made to copyrighted materials when it is believed that such materials can be procured for the use of students.

18. *Questions for further study* should be inserted at frequent intervals, preferably as a concluding part of each lesson. These questions should be formulated with the idea of directing the mind of the student to the essential and important points in the lesson or immediately related thereto.

SUMMARY

In order to conform with the intent of these specifications, each unit course should be written according to the following outline:

PART ONE—TEACHER'S MANUAL

1. Qualifications of student (Item 10).
2. Advantages to be derived by the student (Item 11).
3. Length of the course (Item 12).
4. Equipment and materials (Item 13).
5. Standards for measuring and recording (Item 14).
6. Outline of lessons, projects, or tasks in form of table of contents.
7. In connection with each lesson give specific suggestions for conducting the work, points for review, new points to explain, etc. (Item 9).
8. List of all books or references used in either teacher's or student's manual. Describe each book as follows: Author, title, publisher, address of publisher, price (Item 16).

PART TWO—STUDENT'S INSTRUCTION SHEETS

1. General instructions to students (Item 15).
 2. Lesson sheets arranged in proper order according to table of contents in teacher's manual, using a separate sheet for each lesson.
 3. Each lesson sheet to be arranged as follows: (1) References for study (Item 16).
- (2) Statement of the task (Item 17). (3) Questions for further study (Item 18).

The Federal Board and the Surgeon General invite all to whom this bulletin comes to criticize and suggest improvements in these specifications and to cooperate in extending this series of monographs until it reaches its greatest possible service to the education of our democracy.

LIST OF FIELDS OF INSTRUCTION IN WHICH COURSES HAVE BEEN PREPARED

1. General education: Civics, English, mathematics, penmanship.
2. Commercial subjects: Bookkeeping and accounting, telegraphy, typewriting.
3. Industrial and technical subjects: Automobile mechanics, drafting, electricity, leather work, machine-shop practice, oxyacetylene welding and cutting, painting and decorating, power-plant operating, printing, woodworking.
4. Agricultural subjects: Agricultural specialties, dairy husbandry, dairy industry, farm mechanics, fruit growing, forestry, hog raising, poultry husbandry, vegetable gardening.
5. Physical education.

LIST OF UNIT COURSES—GENERAL EDUCATION

CIVICS

- **Unit 1.**—Practical civics. Joint Series No. 32.

ENGLISH

- **Unit 1.**—For non-English speaking men illiterate in their native languages. Joint Series No. 4.

- **Unit 2.**—For non-English speaking men literate in their native languages. Joint Series No. 5.

- **Unit 3.**—Advanced course in English for foreign-born men literate in their native languages. Joint Series No. 6.

- **Unit 4.**—Elementary writing and reading for English-speaking illiterates. Joint Series No. 7.

- *Unit 5.**—Friendly letter writing for men of limited elementary education.

- Unit 6.**—Personal business letter writing for men of limited elementary education.

- Unit 7.**—Friendly letter writing for men with common-school education.

- Unit 8.**—Personal business letter writing for men with common-school education.

- Unit 9.**—Commercial business letter writing for men with common-school education.

- Unit 10.**—News writing for men with some secondary-school education.

- Unit 11.**—Sales letter writing for men with some secondary-school education.

- Unit 12.**—Oral English for business men with thorough elementary education.

MATHEMATICS

Arithmetic

- **Unit 1.**—For men of limited elementary education. Joint Series No. 13.

- **Unit 2.**—For men with limited common-school education. Joint Series No. 14.

- **Unit 3.**—Vocational arithmetic for agriculturists. Joint Series No. 15.

- **Mathematics 1.**—The use of the slide rule. Joint Series No. 25.

Penmanship

- **Unit 1.**—Left-hand writing for men with right-hand amputations. Joint Series No. 8.

- **Unit 2.**—Legible handwriting for men of limited elementary-school education. Joint Series No. 9.

- **Unit 3.**—For men with common-school education. Joint Series No. 33.

COMMERCIAL SUBJECTS—BOOKKEEPING AND ACCOUNTING

Farm bookkeeping

- *Unit 1.**—Farm bookkeeping, including only a single-entry record of receipts and expenditures.

- *Unit 2.**—Farm bookkeeping, including an annual inventory.

- *Unit 3.**—Farm bookkeeping, including a simple system of cost accounting.

Professional bookkeeping

- **Unit 1.—Small retail business in single entry. Joint Series No. 35.
- *Unit 2.—Calculating and bookkeeping machines for small retail dealers.
- *Unit 3.—Introductory course for professional accountants.
- *Unit 4.—Retail business in double entry for professional accountants.
- *Unit 5.—Partnership business for professional accountants.
- *Unit 6.—Wholesale corporation business for professional accountants.
- *Unit 10.—Introductory course in cost accounting for professional accountants.

TELEGRAPHY

- Units 1 and 2.—Elementary sending and receiving. Parts 1 and 2.
- Unit 3.—Train dispatching.
- Unit 4.—Commercial telegraphy.
- Unit 5.—Typewriting for the telegrapher.
- Unit 6.—Electricity as applied to telegraphy.
- Unit 7.—Railway-station management.

TYPEWRITING

- **Units 1, 2, 3, 4, 5.—Typewriting for professionals and amateurs. Joint Series No. 11.
- **Unit 6.—Sight typewriting for amateurs. Joint Series No. 12.
- Unit 7.—Duplicating devices, extension course.
- Unit 8.—Simple office practice for small offices.
- Unit 9.—An extension course in office practice.

INDUSTRIAL AND TECHNICAL SUBJECTS—AUTOMOBILE MECHANICS

Standard passenger cars

- **Unit 1.—Engines, part 1. Joint Series No. 39.
- *Unit 2.—Engines, part 2.
- Unit 3.—Carburetors.
- Unit 4.—Ignition.
- Unit 5.—Cooling systems.
- Unit 6.—Starting and lighting systems.
- Unit 7.—Clutch.
- Unit 8.—Transmission.
- Unit 9.—Rear-axle drive.
- Unit 10.—Running gear.
- Unit 11.—Tire repair.
- Unit 12.—Radiator repair.
- Unit 13.—Gas-engine science.
- Unit 14.—Storage batteries.
- Unit 15.—Garage, organization and management.
- Unit 16.—Garage records and cost systems.
- Unit 17.—English for automobile workers.
- *Unit 18.—Upkeep and repair of the passenger car for the owner.

Ford passenger cars

- Unit 1.—Engine.
- Unit 2.—Carburetor.
- Unit 3.—Ignition.
- Unit 4.—Cooling system.
- Unit 5.—Starting and lighting.
- Unit 6.—Clutch and transmission.
- Unit 7.—Rear-axle drive.
- Unit 8.—Running gear.
- *Unit 9.—Upkeep and repair for the owner.

Light trucks

List of units not yet prepared.

Heavy trucks

List of units not yet prepared.

Automobile upholstery

Automobile painting and refinishing.

DRAFTING

Machine drafting

****Unit 1.**—Elementary machine drawing. Joint Series No. 36.

***Unit 2.**—Free-hand machine sketching.

***Unit 3.**—Detail and assembly drawing.

Unit 4.—Threads.

Unit 5.—Spur gears.

Unit 6.—Bevel gears.

Unit 7.—Worm and wheel gears.

Unit 8.—Spiral gears.

Unit 9.—Cams.

Unit 10.—Links.

Unit 11.—Machine construction.

Unit 12.—Design of cutters.

Unit 13.—Jigs.

Unit 14.—Isometric drawing.

Unit 15.—Perspective.

Unit 16.—Inking.

Unit 17.—Theory of projection.

Unit 18.—Intersections.

Unit 19.—Oblique projection.

Carpenters' drafting

***Unit 1.**—Plan reading and drawing.

Unit 2.—Simple plan making.

Unit 3.—Cabinet drawing.

Electricians' drafting

Unit 1.—Home wiring diagrams.

Unit 2.—Reading building plans.

Plumbers' drafting

Unit 1.—Plan reading and drawing.

Pattern makers' drafting

Unit 1.—Geometrical construction.

ELECTRICITY

****Unit 1.**—Bell wiring. Joint Series No. 31.

Unit 2.—Principles of direct-current motors and generators.

Unit 3.—Principles of alternating-current motors and generators.

Unit 4.—Principles of electricity.*

***Unit 5.**—Annunciator wiring.

- Unit 6.*—Burglar-alarm wiring.
- Unit 7.*—Fire-alarm wiring.
- Unit 8.*—Interior electric-light wiring.
- Unit 9.*—Switchboard wiring.
- Unit 10.*—Storage batteries.
- Unit 11.*—Care of motors and generators.
- Unit 12.*—Armature winding.
- Unit 13.*—Transformers.
- Unit 14.*—Use of electrical testing instruments.
- Unit 15.*—Electric-meter repairing.
- Unit 16.*—Installation of customer's telephone sets.
- Unit 17.*—Installation of small telephone exchanges.
- Unit 18.*—Telephone trouble hunting on line work.
- Unit 19.*—Telephone trouble hunting on switchboards.
- Unit 20.*—Telephone inspecting.

LEATHER WORK

- **Unit 1.**—Shoe repairing I, hand work. Joint Series No. 29.
- **Unit 2.**—Shoe repairing II, machine work. Joint Series No. 30.
- Unit 3.*—Shoemaking.
- Unit 4.*—Orthopedic shoe fitting.
- Unit 5.*—Harness repair for the small craftsman.
- Unit 6.*—Harness repair with machinery.
- Unit 7.*—Harness making.
- Unit 8.*—Saddlery.
- Unit 9.*—Fancy leather goods manufacture as a home industry.
- Unit 10.*—Designing of fancy leather goods.
- Unit 11.*—Bedside work in leather.

MACHINE-SHOP PRACTICE

- **Unit 1.**—Straight turning between centers. Joint Series No. 16.
- **Unit 2.**—Thread cutting. Joint Series No. 17.
- **Unit 3.**—Chucks and chuck work. Joint Series No. 18.
- **Unit 4.**—Taper turning. Joint Series No. 19.
- **Unit 5.**—Drill-press work. Joint Series No. 20.
- **Unit 6.**—Accurate measuring. Joint Series No. 21.
- **Unit 7.**—Mathematics for the engine lathe. Joint Series No. 22.
- **Unit 8.**—Inspection of machine parts for men without mechanical training. Joint Series No. 23.
- *Unit 9.**—Inspection of machine parts for men with mechanical training.
- *Unit 10.**—Inspection of machine parts, advanced course.
- Unit 11.*—Face-plate turning.
- Unit 12.*—Milling machine.
- Unit 13.*—Shaper.
- Unit 14.*—Planer.
- Unit 15.*—Grinder.
- Unit 16.*—Hardening, tempering, and annealing for general machinists.
- Unit 17.*—Horizontal boring mill.
- Unit 18.*—Bench lathe.
- Unit 19.*—Bench work for small machine shop.
- Unit 20.*—Production estimating, speed setting, and cost systems.
- Unit 21.*—English for machinists.
- Unit 22.*—Mathematics for the milling machine.
- *Unit 23.**—Machine-shop science.

OXYACETYLENE WELDING AND CUTTING

- *Unit 1.—Thin sheet steel welding.
- *Unit 2.—Thick sheet steel welding.
- Unit 3.—Light cast-iron welding.
- Unit 4.—Heavy cast-iron welding.
- Unit 5.—Sheet aluminum welding.
- Unit 6.—Cast aluminum welding.
- Unit 7.—Brazing aluminum welding.
- Unit 8.—Malleable-iron welding.
- Unit 9.—Welding dissimilar metals.
- Unit 10.—Pressure containers.
- Unit 11.—Cutting iron and steel.
- Unit 12.—Job practice.

PAINTING AND DECORATING

- **Unit 1.—Treatment of new walls and ceilings. Joint Series No. 38.
- *Unit 2.—Treatment of old walls and ceilings.
- Unit 3.—Treatment of new woodwork.
- Unit 4.—Treatment of brickwork.
- Unit 5.—Treatment of ironwork.
- *Unit 6.—Kalsomining and whitewashing.
- Unit 7.—Mixing colors.
- Unit 8.—Stencils, ornaments, and designs.
- Unit 9.—Furniture finishing.
- Unit 10.—Furniture painting.
- Unit 11.—Sign painting.
- Unit 12.—Show-card lettering.
- Unit 13.—Scenic painting.
- *Unit 14.—Paper hanging.

POWER-PLANT OPERATING

- **Unit 1.—Starting up and shutting down the steam plant. Joint Series No. 37.
- *Unit 2.—Starting up and closing down the electric plant.
- Unit 3.—Pump injectors and water heaters.
- Unit 4.—Firing with different grades of fuel.
- Unit 5.—Types of boilers and their construction.
- Unit 6.—Refrigeration plants.
- Unit 7.—Elevators.

PRINTING

- *Unit 1.—Elementary composition.
- *Unit 2.—Punctuation and spelling.
- *Unit 3.—Proof reading.
- *Unit 4.—Principles of design.
- Unit 5.—Study of type faces design.
- *Units 6, 7, and 8.—Job composition.
- *Units 9 to 16.—Book composition.
- Unit 17.—Imposition and stonework.
- Unit 18.—Free-hand lettering.
- Unit 19.—Color harmony.
- Unit 20.—Technical terms.
- Unit 21.—Advertising composition.
- Unit 22.—Tabular composition.
- Unit 23.—Papers.
- Unit 24.—Inks.
- *Unit 25.—Linotype operation.
- Unit 26.—Monotype operation.

- Unit 27.*—Cost accounting.
- Unit 28.*—Estimating.
- Unit 29.*—Stock cutting.
- Unit 30.*—Multigraph printing.
- Unit 31.*—Multicolor printing.

WOODWORKING

- Unit 1.*—Elementary hand woodwork.
- Unit 2.*—House carpentry.
- Unit 3.*—Wood-pattern making.
- Unit 4.*—Cabinetmaking.
- Unit 5.*—Therapeutic woodworking.
- **Unit 6.*—Care of common woodworking tools.
- ***Unit 7.*—Use of steel square in house framing. Joint series No. 40.

AGRICULTURAL SPECIALTIES

Vegetable gardening

- Units 1 and 2.*—Kitchen gardening under village and suburban conditions, basic and extension courses.
- Units 3 and 4.*—Market gardening, basic and extension courses.
- Unit 5.*—Home gardening for farmers, extension course.

Fruit growing

- Unit 1.*—Orchard fruits as a side line for farmers.
- Unit 2.*—Small fruits as a side line for farmers.

Forestry

- Unit 1.*—Forestry for prospective forest wardens.
- Unit 2.*—Forestry for prospective forest rangers.
- Unit 3.*—Forestry for prospective forest superintendents.

Hog raising

- **Units 1 and 2.*—Pig raising as a side line, basic and extension courses.
- **Unit 3.*—Pork production as a primary industry.

Poultry raising

- **Units 1 and 2.*—Poultry raising as a side line for farmers, basic and extension courses.
- Units 3 and 4.*—Poultry raising as a side line for village residents, basic and extension courses.
- Unit 5.*—Poultry raising as a primary industry.

Beekeeping

- Unit 1.*—Beekeeping as a side line.

Bookkeeping

- Units 1, 2, and 3.*—Farm bookkeeping. See bookkeeping list.

Farm mechanics

- ***Unit 1.*—Woodworking for the general farm. Joint series No. 26.
- ***Unit 2.*—Woodworking for the poultry farm. Joint series No. 27.
- ***Unit 3.*—Woodworking for the dairy farm. Joint series No. 28.
- Unit 4.*—Woodworking for the fruit farm.
- **Unit 5.*—Ropework, basic course.
- Unit 6.*—The farm tractor, small type.
- Unit 7.*—The stationary gas engine.
- Unit 8.*—Care and upkeep of farm machinery.
- **Unit 9.*—Concrete work for the farmer.

Dairy husbandry

- Units 1 and 2.*—Dairy husbandry as a side line.
Unit 3.—Feeds and feeding.
Unit 4.—Care and management.
Unit 5.—Dairying as a primary business.
Unit 6.—Course for dairy herdsmen.
Units 7 and 8.—Farm dairying, basic and extension courses.
Units 9 and 10.—Commercial butter making, basic and extension courses.
Unit 11.—Cheese making, basic and extension courses.
Unit 12.—Babcock tester on the farm.
Unit 13.—Advanced registry work.

PHYSICAL EDUCATION

- **Unit 1.**—Calisthenics for curative purposes. Joint series No. 33.
****Unit 2.**—Exercises for orthopedic cases. Joint series No. 34.
***Unit 3.**—Free exercises for cardiac cases.
Unit 4.—Exercises for amputation cases.
Unit 5.—Attachments for games for amputation cases.
Unit 6.—Games for convalescents.
Unit 7.—Games for ward patients.
Unit 8.—Stunt programs.
Unit 9.—Tournaments in quoits, checkers, and chess.
Unit 10.—Use of commands and teaching new exercises.
Unit 11.—Active games for psychopaths.
Unit 12.—Music in reconstruction education.

List of unit courses corrected according to changes in series numbers

(Revision of Mar. 8, 1919)

New No.	Old No.
1	1. To the disabled soldiers and sailors in the hospitals.
2	2. To the household of the disabled soldiers and sailors.
3	3. To the returning disabled soldiers.
4	4. English 1—For non-English speaking men illiterate in their native languages.
5	5. English 2—For non-English speaking men literate in their native languages.
6	6. English 3—Advanced course in English for foreign-born men literate in their native languages.
7	7. English 4—Elementary writing and reading for English-speaking illiterates.
8	8. Penmanship 1—Left-hand writing for men with right-hand amputations.
9	9. Penmanship 2—Legible handwriting for men of limited elementary school training.
10	11. Typewriting 1, 2, 3, 4, 5—For professionals and amateurs.
11	12. Typewriting 6—Sight typewriting.
12	33. Physical Education 1—Calisthenics for curative purposes.
13	13. Arithmetic 1—For men of limited elementary education.
14	14. Arithmetic 2—For men with limited common-school education.
15	16. Machine-shop Practice 1—Straight turning between centers.
16	17. Machine-shop Practice 2—Elementary thread cutting.
17	18. Machine-shop Practice 3—Chucks and chuck work.
18	19. Machine-shop Practice 4—Taper turning.
19	20. Machine-shop Practice 5—Drill-press work.
20	21. Machine-shop Practice 6—Accurate measuring.
21	22. Machine-shop Practice 7—Mathematics for the engine lathe.
22	10. Penmanship 3—For men with common-school education.
23	15. Arithmetic 3—Vocational arithmetic for agriculturists.
24	23. Machine-shop Practice 8—Inspection of machine parts, basic course.
25	24. Specifications and prospectus for the joint series of rehabilitation courses for disabled soldiers.
26	25. Mathematics 1—Use of the slide rule.

New No.	Old No.	
27	26.	Farm Mechanics 1—Woodworking for the general farm.
28	27.	Farm Mechanics 2—Woodworking for the poultry farm.
29	28.	Farm Mechanics 3—Woodworking for the dairy farm.
30	29.	Shoe Repairing 1—Handwork necessary to prepare shoes for machine finishing.
31	30.	Shoe Repairing 2—Machine work.
32	31.	Electricity 1—Bell wiring.
33	32.	Civics 1—Practical civics.
34	34.	Physical Education 2—Exercises for orthopedic cases.
35	39.	Auto Mechanics 1—Engine repairing 1.
36	37.	Power-plant Operating 1—Starting up and shutting down the steam plant.
37	35.	Bookkeeping 1—Introductory exercises in bookkeeping for professional accountants.
38	38.	Painting and Decorating 1—Painting new walls and ceilings.
39	36.	Drafting 1—Elementary machine drawing.
40	40.	Woodworking 1—The steel square and its uses in house framing.
41.		Woodworking 2—Care of woodworking tools.
42.		Physical Education 3—Graded exercises for cardio-vascular cases.
43.		Printing 2—Spelling and punctuation for printers.
44.		Printing 3—Proofreading.
45.		Sheet-metal Working 1—Soldering.
46.		Sheet-metal 2—Essentials of sheet-metal work.
47.		Painting and Decorating 3—Kalsomining and whitewashing.
48.		Mathematics 2—Mathematics for universal milling machine.
49.		Bookkeeping 2—Retail business in double entry for professional accountants.
50.		Drafting 2—Machine details.
51.		Drafting 3—Thread work.
52.		Painting and Decorating 3—Treatment of old walls and ceilings.
53.		Drafting 4—Blue-print reading for carpenters.
54.		Machine-shop Practice 9—Inspection of machine parts 2.
55.		Power-plant Operating 2—Starting up and closing down the electric plant.
56.		Telegraphy 1—Sending for the beginner.
57.		Telegraphy 2—Sending and receiving for the beginner.
58.		Electricity 2—Annunciator wiring.
59.		Auto Mechanics 2—Ford automobile upkeep and repair for owners.
60.		Auto Mechanics 3—Automobile upkeep and repair for owners.
61.		Auto Mechanics 4—Engine repairing 2.
62.		Bookkeeping 3—Farm receipts and expenditures in single entry.
63.		Bookkeeping 4—Farm accounts and inventory.
64.		Printing 1—Elementary composition for printers.
65.		Printing 4—Elementary Book composition.
66.		Bibliography—Books for students and instructors in United States Army hospitals.
67.		Bookkeeping 5—Partnership business for professional accountants.

Rehabilitation monograph. Joint series No. 26.

Unit Course—Mathematics I—Use of the Slide Rule

USE OF THE SLIDE RULE

February, 1919—Trial edition

PART I. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF THE STUDENT

The slide rule can be taught successfully to a man who has had an education equivalent to that given in six grades of the elementary schools. More advanced work can be done with a high-school or a college graduate. The instruction sheets are written for the man of sixth-grade education. For the high-school or college man, more advanced work is suggested, including references to several good manuals and sets of problems.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

The slide rule enables one to perform many of the calculations used in commercial and industrial life with accuracy, speed, and very little mental effort. Finding per cents, multiplication, division, proportion, and square root are performed very quickly. A glance at the problems will give some idea of the application of the slide rule. It is easily learned and very fascinating to the student.

3. LENGTH OF THE COURSE

A student should be able to cover the 10 problem sheets in 10 lessons of one hour each. These sheets contain the essentials of the subject. Assignments for additional study may be made in the reference books noted.

4. EQUIPMENT AND MATERIALS

1. Slide rule, 10-inch "Favorite" with additional numberings, made by Keuffel & Esser, 127 Fulton Street, New York City. Price, \$2.45.

5. STANDARDS FOR MEASURING AND RATING STUDENT'S WORK

For recording the student's proficiency, the percentage scale is recommended.

For testing the student, problems may be selected from the chapter on "The Slide Rule" in "Shop Problems," using those similar to the problems completed by the student. The time required to do the problem should be recorded on the answer paper handed in by the student. This time should be taken into account in grading the work of the student. At first he should be given all the time he needs, care being taken to see that he does not do the work by arithmetic. Give him a set of problems, instructing him first to work them straight through, setting down the results; then go over them a second time without looking at the first results. Check the first list by the second until they agree.

Tests

Count every question worth 20 credits.

If the figure (from the left) is correct, 5 credits.

If the second figure is correct, 5 credits.

If the third figure is correct, 5 credits.

If the decimal point is correct, 5 credits.

An answer correct within one point in the third figure should be counted correct.

Answers to test problems following lesson X

1. 3.15; 2. 1.41; 3. 11.4; 4. 36.8; 5. 13.5

If you find the suggested scale of marking too severe, construct a scale on a similar plan that seems to fit your conditions.

6. OUTLINE OF LESSONS

1. Multiplication, division, squares and square roots of easy numbers of one digit.

Exercises 1-11.

2. Multiplication of numbers of two figures. Exercises 12-26.

3. Multiplication of numbers of two figures. Exercise 27.

4. Division and per cents, two figures. Exercises 28-35.

5. Per cents, with three figures. Exercises 36-48.

6. More than three figures—multiplication and division. Exercises 49-59.

7. Proportion. Exercises 60-68. (A mil is an angle equal to $\frac{1}{6400}$ of 360° . It is the unit of angle used by the Artillery.)

8. Squares. Exercises 69-83.

9. Square roots. Exercises 84-101.

10. Multiplying more than two numbers together. Exercises 102-105.

7. SUGGESTIONS FOR TEACHING

Motivation.—Try to find some problem in which the student will be interested along the line of his occupation, past or future. Show him how he can save time and energy by using the slide rule. He will find that the rule is a fascinating instrument and easily mastered.

Use of student's instruction sheets.—For convenience in printing, the instructor's manual and the student's instruction sheets are printed in the same pamphlet. It is intended that the student's instruction sheets shall be given to the student one at a time, lesson by lesson. To do this it will be necessary to cut them out of the book. Enough copies of the bulletin will be provided for this or typewritten copies can readily be made. With exceptional students it may be wise to give them the complete bulletin at one time.

Answers to illustrative problems are given with the problems.

Answers to problems for drill are given on a separate sheet which may be placed in the hands of the student at the discretion of the instructor.

For students with strong mathematical foundation or exceptional ability, additional problems may be selected from the following books.

8. BOOKS

1. Breckenridge, Mersereau & Moore, "Shop Problems," Ginn & Co., 70 Fifth Avenue, New York City. \$1.20. Chapter on "The Slide Rule."

2. The Manheim Slide Rule, Keuffel & Esser Co., 127 Fulton Street, New York City. (This comes with the slide rule.) \$0.50.

3. The Slide Rule Simplified, by George W. Richardson, 4212 Twenty-fourth Place, Chicago, Ill. \$1.00.

9. ANSWERS

Answers given with the problems are not given below.

	31	32	33	34
21	651	672	693	714
22	682	704	726	748
23	713	736	759	782
24	744	768	792	816
25	775	800	825	850
26	806	832	858	884
27	837	864	891	918
28	818	896	924	952
29	899	928	957	986

30. 49 per cent.
31. 33 per cent.
32. 91 per cent.
33. 58 per cent.
34. 16 per cent.
35. 21 per cent.
39. 2. 24.
40. 2. 34.
41. 1. 33.
42. 1. 32.
43. 3. 18.
44. 67. 3
45. 48. 9.

46. 0. 0000476.
47. 5. 77.
48. 27. 5.
52. 156.
53. 0. 294.
55. 0. 00654.
56. 0. 735.
57. 0. 615.
58. 13. 6.
59. 77. 9.
61. 19. 6.
62. 21. 4.
63. 33. 1.

64. 13. 9.
65. 10. 5.
66. 56. 7.
67. 1.6 mils.
72. 10. 2.
73. 21. 6.
74. 1. 25.
75. 74. 8
76. 76. 200.
77. 1. 170.
78. 0. 436.
79. 0. 0039.

80. 0. 0000325.
81. 0. 00595.
82. 5, 020, 000.
91. 1. 19.
92. 3. 76.
93. 11. 9.
94. 0. 0377.
95. 1. 56.
96. 9. 24.
97. 0. 604.
98. 0. 560.
99. 38. 2.

100. Square roots of numbers 110–130.

110. 10. 5.	116. 10. 8.	122. 11. 0.	127. 11. 3.
111. 10. 5.	117. 10. 8.	123. 11. 1.	128. 11. 3.
112. 10. 6.	118. 10. 9.	124. 11. 1.	129. 11. 4.
113. 10. 6.	119. 10. 9.	125. 11. 2.	130. 11. 4.
114. 10. 7.	120. 11. 0.	126. 11. 2.	
115. 10. 7.	121. 11. 0.		

101. $127\frac{1}{4}$ feet. (Find the hypotenuse of the right triangle whose sides are each 90 feet.)

102. Use $\frac{5}{8}$ and $1\frac{3}{4}$ inch in the decimal form.

Find $\sqrt{(.625)^2 + (1.75)^2} = 1.9$ inches. (Use a 2-inch pipe, the nearest standard size.)

103. $8\frac{1}{2}$ inches. (Use a 9-inch pipe, the nearest standard size.)

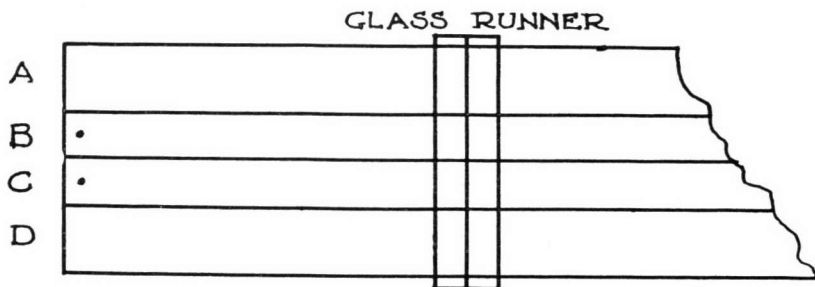


FIG. 1

PART II. STUDENTS' INSTRUCTION SHEETS.

(Every man a lightning calculator—Let the slide rule do your work. You push the slide, the rule does the rest)

LESSON 1

The slide rule is an instrument that may be used for saving time and labor in most of the calculations that occur in the practical problems of the business man, mechanic, draftsman, engineer, or estimator.

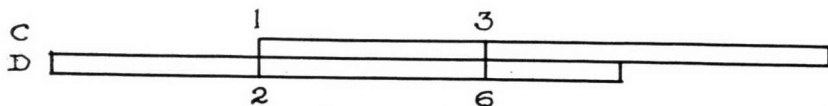


FIG. 2.— $2 \times 3 = 6$ or $6 \div 3 = 2$

In order that you may see how the rule is used on easy problems where you know the answers, let us take the following:

1. $2 \times 3 = ?$

There are four scales on the rule, A, B, C, and D, as shown in Figure 1.

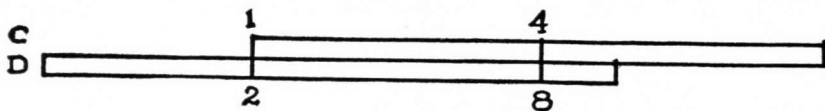


FIG. 3.— $2 \times 4 = 8$ or $8 \div 4 = 2$

Set 1 on scale C opposite 2 on scale D. Then move the glass runner to 3 on scale C. Directly below this 3, you will find 6, the answer. (Fig. 2.)

In the same way, try a few more easy ones.

2. $2 \times 2 = ?$

3. $2 \times 4 = ?$ (See fig. 3.)

4. $3 \times 3 = ?$ (See fig. 4.)

Now for easy ones in division.

5. $6 \div 3$. (See fig. 2.)

Opposite 6 on scale D, set 3 on scale C. Look along C to the left till you come to 1 at the end of the slide. Under this 1, on scale D, you will find 2, the answer.

6. $8 \div 4$. (See fig. 3.)

7. $9 \div 3$. (See fig. 4.)

Now you can multiply and divide.

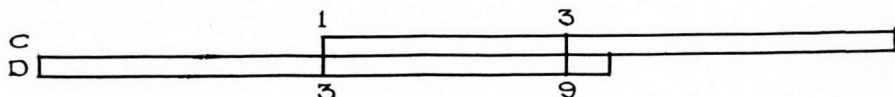


FIG. 4.— $3 \times 3 = 9$ or $9 \div 3 = 3$

But what is the use of having the other scales, since we have only used C and D? That brings us to squares and square roots.

You will remember that to square a number means to multiply the number by itself; e. g., 3^2 means $3 \times 3 = 9$.

8. On the rule, this would be done as follows: Set the hair line of the glass runner to 3 on scale D. Above, on scale A, opposite the hair line you will find 9. (Fig. 5.)

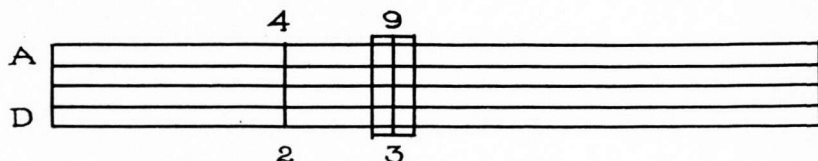


FIG. 5.— $3^2 = 9$ and $2^2 = 4$

Also $\sqrt{9} = 3$ and $\sqrt{4} = 2$

9. In the same way try 2^2 . (See fig. 5.)

To get square roots you simply do the work in the reverse order.

10. Find the square root of 9; i. e., find the number which multiplied by itself will give 9.

The square root of 9 is indicated thus: $\sqrt{9}$.

Set the hair line of the runner to 9 on scale A, being careful to use the 9 on the left-hand half of the rule, because the other 9 is really 90. Below, on scale D, you will find 3, the answer. (Fig. 5.)

In the same way, try

11. $\sqrt{4}$.

Set the runner to 4 on A. Opposite the hair line on scale D you will find 2, the answer. (Fig. 5.) Too easy? All right. We come next to some that are a bit more difficult.

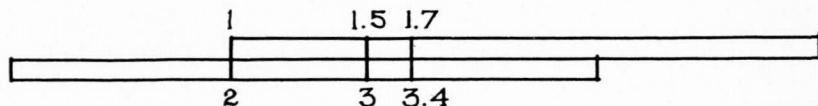


FIG. 6.— $2 \times 1.5 = 3$
and $2 \times 1.7 = 3.4$

LESSON II

2×1.5 .

Set 1 on C to 2 on D. Move the runner to 1.5 on C. This will be halfway between 1 and 2. Under the hair line of the runner, find 3 on D. (Fig. 6.)

13. 2×1.7 . Using Figure 6, see if you can make it 3.4. The tenths on D are the large subdivisions.

14. 1.5×2.5 . Set 1 on C to 1.5 on D. Move the runner to 2.5 on C. Below 2.5 on D, find 3.75, the answer. Note that this answer is halfway between 3.7 and 3.8 which makes it 3.75. (Fig. 7.)

15. 2×15 .

This is worked on the rule exactly like example 12, but you can see by looking at the problem that the answer is 30 and not 3.

16. 20×15
 17. 200×15
 18. 20×150
 19. $2 \times .15$
 20. $2 \times .015$
 21. $.2 \times 15$
 22. $.02 \times .015$

All of these problems are worked like Example 12. As far as the rule is concerned, you multiply 2 by 1.5 and get 3. Then you place the decimal point by inspection. You will remember that in multiplying decimals you first multiply as though there were no decimal point, then point off as many decimal places in the answer as there are in both numbers to be multiplied together. Thus, in problem 22, there are two decimal places in 0.02 and three in 0.015. So in the answer, 30, we must have 2+3, or 5 places, making the result 0.00030. Of course the 0 at the right does not count, and the final answer is 0.0003.

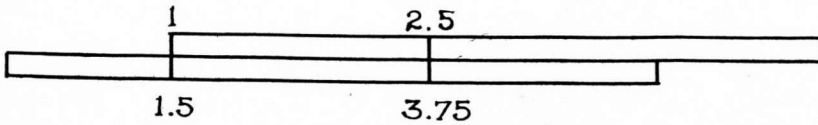


FIG. 7.— $1.5 \times 2.5 = 3.75$

From these examples you see that the decimal point is not considered in operating the slide rule. After the work of the rule has been done, the decimal point is placed by looking at the problem and making a rough calculation.

23. 20×32 .

By looking at the example, you see that the units figure is 6 because $2 \times 3 = 6$. On the rule, the hair line comes a little beyond 735 which is evidently 736.

If you had nothing but the rule to tell you, the third figure might be 6 or 7. So when you read numbers on the slide rule, you can be sure of the first two figures, and the third will not be more than one point away from the correct result.

Now for the decimal point.

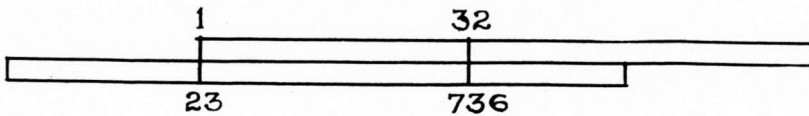


FIG. 8.— $23 \times 32 = 736$

You know that 23×32 is roughly 20×30 , or 600. Then place the decimal point in 736 so that the result will look as much like 600 as possible. You can see that the answer is 736. (Fig. 8.)

24. 18×34 .

On the rule the result is a little over 61. Looking at the problem, you can see that $4 \times 8 = 32$, hence there will be 2 in the third place. Now you have 612.

By a rough calculation the problem is about equal to $20 \times 30 = 600$. Hence you make 612 look like 600 by placing the decimal point after the 2. The answer is 612.

25. 16×24 . Answer 384.

26. 14×26 . Answer 364.

37046—27—36

LESSON III

27. Fill in the blank spaces in the following multiplication table, using the slide rule.

	31	32	33	34
21				
22				
23				
24				
25				
26				
27				
28				
29				

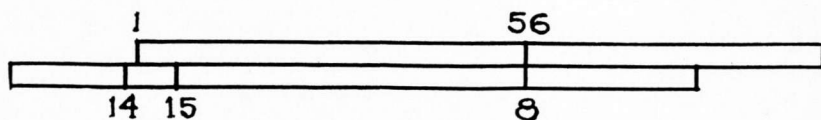


FIG. 9.— $8 \div 56 = 0.14$

LESSON IV

28. Suppose you are earning 56 cents per hour and you are given an increase of 8 cents. What per cent increase do you receive?

Of course you will divide 8 by 56.

To divide one number by another on the slide rule, you simply reverse the order of the work you have been doing in multiplication.

Set the runner to 8 on scale D.

Move the slide so as to set 56 on C to the hair line of the runner. (Fig. 9.)

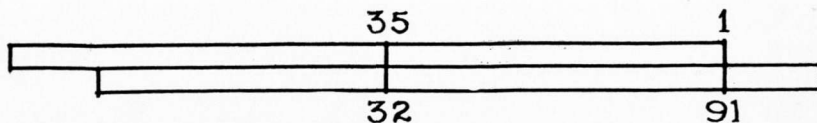


FIG. 10.— $32 \div 35 = 0.91$

Under 1 on C you will find 14 and a little over. But the result is nearer 14 than 15. Hence the result correct to 2 figures is 14. By inspection, the decimal point must be placed before the number making the answer 0.14, or 14 per cent.

29. Before the war a man earned 35 cents per hour. While recovering from wounds, he learned a new trade which increased his earning power to 67 cents per hour. What per cent increase did he receive?

His increase is 32 cents per hour. The per cent of increase is found by dividing 32 by 35.

Set the runner to 32 on D.

Set 35 on C to the runner line. The result would be found under the 1 at the extreme left of scale C, but this 1 projects beyond scale D. So we use the 1 on the extreme right of scale C. Under this 1, find 91 on scale D. (Fig. 10.)

We will now call the 1 at the extreme left of scale C the left-hand index, and the 1 at the extreme right of scale C the right-hand index.

In the same way, just for practice, try the following:

30. What per cent of 91 is 45? (Divide 45 by 91.)
31. What per cent of 73 is 24?
32. What per cent of 67 is 61?
33. What per cent of 53 is 31?
34. What per cent of 82 is 13?
35. What per cent of 42 is 9?

I think you can see that the slide rule is very useful in obtaining per cents.

LESSON V

If you have a long report to make out in which there are a large number of per cents to be calculated, why not use the slide rule?

A secretary to the president of a big corporation recently said: "The slide rule does my work in one-third of the time that would be required otherwise." But suppose you had to get per cents in a problem like the following:

36. A baseball player made 57 hits out of 286 times at bat. What is his percentage?

Opposite 57 on D set 286 on C. When you look for 286, observe that between 2.8 and 2.9 there are five spaces on the rule. Then every space counts one-fifth of a tenth or one-fifth of 0.1 which is 0.02. Since you want six points for your third figure, you have to use three spaces every one worth 0.02. $3 \times 0.02 = 0.06$.

Under the left-hand index find 199. When you read the result, you see that it comes on the rule between 1.9 and 2.0. There are 10 spaces between 1.9 and 2.0. Hence every space counts one point. You see that just a little practice in decimals enables you to read the rule to three figures. Now we must place the decimal point. A rough calculation shows that $\frac{57}{286}$ is nearly $\frac{60}{300}$ or $\frac{1}{5}$. Then the decimal point must be placed so as to make your result somewhere near one-fifth or 0.2. Evidently the answer is 0.199. This may be read $19\frac{9}{100}$ per cent or $19\frac{9}{10}$ hundredths or 199 thousandths.

37. If your income is \$2,500 per year and you save \$453, what per cent do you save?

Opposite 453 on D set 25 on C. Under the index find 181 on D. Hence the answer is 0.181 or $18\frac{1}{10}$ per cent. You will note that when you look for the 3 in 453 on the rule, there are only two spaces between 45 and 46. Then each space counts one-half of a hundredth, or one-half of 0.01, which is 0.005, or five points for the third figure.

Since you want three points, you must estimate three-fifths of a space as nearly as possible.

38. If your salary is \$57.50 per week, and you are given an increase of \$12.40, what per cent increase do you receive?

Opposite 124 on D set 575 on C. This means that between 5 and 6 on C you must take 7 of the large divisions and one of the small divisions. Under the right-hand index read 216 on D. Hence the answer is $21\frac{6}{10}$ per cent.

Just a few more problems with three figures so you may increase your speed in operating the rule.

39. $5.42 \div 2.42$.
40. $7.35 \div 3.14$.
41. $6.13 \div 4.61$.
42. $9.56 \div 7.26$.
43. $10 \div 3.14$.

For 10, use either the right or left hand index.

- | | |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 44. $16.5 \div .245$ | $\left\{ \begin{array}{l} \text{To place the decimal point these problems are roughly:} \\ 16 \div .2 = 80. \\ .0070 \div .0001 = 70. \\ .0015 \div 30 = .00005. \\ .36 \div .06 = 6. \\ .038 \div .001 = 38. \end{array} \right.$ |
| 45. $.00655 \div .00034$ | |
| 46. $.00156 \div 32.8$ | |
| 47. $.375 \div .065$ | |
| 48. $.0385 \div .001$ | |

Here is another method of placing the decimal point in division. Work the problem as though both dividend and divisor were integers (i. e., not decimals) pointing off as usual. Move the decimal point to the left as many places as there are decimal places in the dividend.

Then move it to the right as many places as there are decimal places in the divisor. For example, in Example 44, $165 \div 245$ gives 0.673. Move the point one place to the left because there is one decimal place in the dividend, giving us 0.0673. Then move it three places to the right, because there are three decimal places in the divisor, giving as a result 67.3.

Try both methods and see which you like better. Let one check the other.

Suppose you had more than three figures as in the following example:

49. Find the circumference of a wheel 28 inches in diameter.

Here you must multiply 28×3.1416 . But the slide rule reads only to three figures. So cut off the fourth and fifth figures in 3.1416 and call it 3.14, since the number is nearer 3.14 than 3.15.

50. Multiply 26 by 3.1456.

In this case call 3.145 equal to 3.15, since the number is nearer 3.15 than 3.14.

However, we have very little use for numbers of more than three figures. When we do need them, we can use multiplication tables or counting machines.

LESSON VI

51. If bell metal is made of 25 parts of copper to 11 parts of tin, find the weight of tin in a bell weighing 404 pounds.

The tin is evidently eleven thirty-sixths of 404, or $\frac{11 \times 404}{36}$.

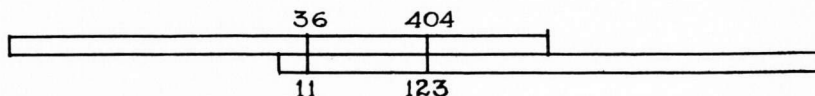


FIG. 11. $\frac{11 \times 404}{36} = 123$

Opposite 11 on D set 36 on C.

Move the runner to 404 on C.

Under the runner line read 123 on D.

To place the decimal point, make a rough calculation as follows: The example is roughly equal to $\frac{10 \times 400}{40} = 100$. —makes 123 look as near 100 as possible by placing the point after the 3.

The answer is 123 pounds of tin.

For speed try the following:

52. $\frac{14 \times 525}{47}$

53. $\frac{24.5 \times 43.4}{3620}$

54. $\frac{1.35 \times 3.15}{6.2}$

Opposite 1.35 on D, set 6.2 on C. If we try to move the runner to 315 on C, it is impossible because 315 lies beyond the extremity of D. In such a case proceed as follows: Move the runner to the right-hand index of C. Then move the slide, setting the left-hand index of C to the runner line. Now we can move the runner to 315 on C and read the result under the hair line on D. The answer is 686. A rough calculation for the decimal point gives us $\frac{1 \times 3}{6} = \frac{3}{6}$, or 0.5. Making 686 look as much as possible like 0.5, we have .686.

55. $\frac{2.28 \times .0125}{4.36}$. (The rough calculation for the decimal point might be $\frac{2 \times .012}{42} = .006$.)

56. $\frac{7.63 \times 2.34}{24.3}$

57. $\frac{2.56 \times 1.78}{7.4}$

58. $\frac{82.5 \times 9.3}{56.5}$

59. $\frac{32.6 \times 22.1}{9.25}$

LESSON VII

60. If an aeroplane flying 100 miles per hour travels 86 miles in a given time, how far will an automobile traveling 22 miles per hour go in the same time?

Writing this in the form of a proportion:

$$100:86=22:x,$$

which means 100 is to 86 as 22 is to the answer.

The work on the rule is as follows:

$$\begin{array}{cc} C & D \end{array} \quad \begin{array}{cc} C & D \end{array}$$

$$100:86=22:x.$$

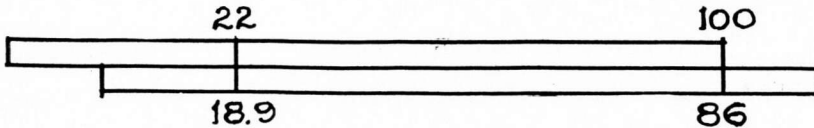


FIG. 12.— $100:86=22:18.9$

Opposite 86 on D set 100 on C. (Use right index for 100.) Move the runner to 22 on C and under the hair line on D read the answer 18.9.

In placing the decimal point, note that 100 has the same relation to 86 that 22 has to the answer. Since 86 is about nine-tenths of 100, we must place the decimal point in 189 so that the answer shall be about nine-tenths of 22. Hence the answer is 18.9.

In the same way solve the following proportions:

61. $24:31=15.2:x.$

62. $1.4:2.5=12:x.$

63. $3.71:2.4=51.2:x.$

64. $2.54:4.72=7.48:x.$

65. $12.3:15.2=8.5:x.$

Problems from Camp Taylor (Field Artillery Training School):

66. If a post 13.2 feet high casts a shadow 27.2 feet long, how high is a tower which casts a shadow 116.8 feet long?

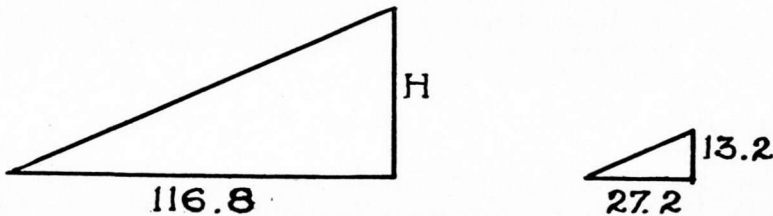


FIG. 13.— $27.2:13.2=116.8:h$

$$27.2:13.2=116.8:h.$$

Solve like example 50.

67. At 2,400 yards an increase of 1 mil in elevation increases the range 25 yards. What change in elevation will increase the range 40 yards? The mil is the unit of angle in the Artillery. It is equal to $\frac{1}{6400}$ of 360 degrees.

68. The effects of the wind on a shell are approximately proportional to the velocity of the wind. At 3,000 yards for the 3-inch gun, a rear wind of 10 miles per hour increases the range 30.1 yards. What wind will increase the range 42.8 yards? Answer: Rear wind of 14.2 miles per hour. What wind will decrease the range 68.5 yards? Answer: Head wind of 22.8 miles per hour.

LESSON VIII

Squares

69. Find the area of a square plot of ground measuring 128 yards on a side. Set the runner to 128 on D. Directly above on A is the square required, 164. To find the place for the decimal point, make a rough calculation.

$(128)^2$ is roughly $(130)^2 = 16900$. Then make 164 look like 16900 by placing the point as follows: 16400.

Case I: When the given number lies between 1 and 10, if the runner is set to this number on D, the square will be found opposite the runner line on A.

70. *Example*.—Square 6.5.

The runner set to 6.5 on D indicates the square 42.25 on A. Notice that on the A scale the reading is from 1 to 100 with 10 in the middle of the rule.

Case II: When the given number does not lie between 1 and 10, square as in Case I and then place the decimal point by a rough calculation.

71. *Example*.—Square 652.

Set the runner to 6.52 on D reading the square 425 on A. Roughly $(652)^2 = (600)^2 = 360,000$. To make 425 look as much as possible like 360,000, the decimal point must be placed as follows: 425,000. Notice that here the actual arithmetic square would be 425104, but on the slide rule we can only get the first three figures 425. This, however, is close enough for most practical purposes, such as estimating or contract work.

Find the square of:

72. 3.2.	75. 8.65	78. 0.66.	81. 0.0244.
73. 4.65.	76. 276.	79. 0.0625.	82. 2,240.
74. 1.12.	77. 34.2.	80. 0.0057.	

83. Find the area of a circular plot of ground measuring 14.5 yards in diameter.

Use the formula $A = 0.7854 d^2$, which means the area of a circle is equal to 0.7854 multiplied by the square of the diameter.

Set the runner to 145 on D. The square is found directly above on A, but need not be read. Set the right-hand index of the slide to the runner line. Move the runner to 0.7854 on B. Find the result, 269, on A.

LESSON IX

Square root

84. How long must I make one side of a square garden bed to contain 8 square yards? Here we have to find the square root of 8.

Set the runner to 8 on scale A. Note that scale A runs from 1 to 100, so that 8 is found in the left-hand half of the rule.

Now opposite the runner line on scale D, find 2.82, the square root.

Then the result is 2.82 yards.

85. Find $\sqrt{3}$.

Set the runner to 5 on A.

Opposite the runner line find 1.73 on D.

86. Find $\sqrt{30}$.

Set the runner to 30 on A, being careful to notice that 30 is indicated by 3 on the right-hand of the rule. Opposite the runner line on D, find 5.48.

87. Find $\sqrt{300}$.

Since scale A only runs from 1 to 100, 300 is not found on the rule. Move the decimal point an even number of places so that you will get a number that is on the rule. This can be done by moving the point two places to the left, giving $\sqrt{3.00}$.

Find $\sqrt{3}$, which is 1.73. Then move the decimal point half as many places as it was moved in the first place, but in the opposite direction. In this case, move the point in 1.73 one place to the right, giving as a result, 17.3.

88. Find $\sqrt{.30}$.

Move the point two places to the right, obtaining 30.

Find $\sqrt{30} = 5.48$.

Move the point one place to the left, obtaining 0.548 for the result.

89. Find $\sqrt{.03}$.

Move the decimal point two places to the right, obtaining $\sqrt{3}$.

Find $\sqrt{3} = 1.73$.

Move the point one place to the left, obtaining 0.173.

90. Find $\sqrt{.003}$.

Move the point four places to the right, obtaining $\sqrt{30}$.

Find $\sqrt{30}=5.48$.

Move the point two places to the left, obtaining .0548.

Find the square roots of:

91. 1.42.

94. 0.142.

96. 85.4.

98. 0.31416.

92. 14.2

95. 2.43.

97. 0.365.

99. 1450.

93. 142.

100. Make a list of square roots of whole numbers between 110 and 130.

101. On a baseball field, find the distance from home plate to second base, measured in a straight line. (The distance between bases is 90 feet.)

102. Water is conducted into a tank through two lead coil pipes having diameters of $\frac{5}{8}$ and $1\frac{3}{4}$ inches, respectively. Find the size of the lead waste pipe that will allow the water to run out as fast as it runs in.

103. Two branch iron sewer pipes, each 6 inches in diameter, empty into a third pipe. What should be the diameter of this third pipe in order to carry off the sewage?

LESSON X

When more than two numbers are to be multiplied together

104. Find the product of $3.2 \times 52 \times .24$.

Find 3.2×52 as usual, obtaining 166. Set the left-hand index to the runner line. Move the runner to 24 on C. Opposite the runner on D, read the answer, 39.9.

105. Find the product of $7.2 \times 3.2 \times .25 \times 5.4$.

7.2×32 gives 230. Set the left index to the runner. Move the runner to 25 on C. Opposite the runner on D, read 576. The product of the first three numbers is 57.6.

Set the right index to the runner line. Move the runner to 5.4 on C. On D opposite the runner line, read 311. The decimal point is placed by a rough calculation. The problem—

$7.2 \times 3.2 \times .25 \times 5.4$ is roughly equal to

$10 \times 3 \times .2 \times 5$ is 30.

Then 311 must be made to look as much as possible like 30. In order to do this, evidently the answer is 31.1.

106. Find the product of $.75 \times 1.1 \times 6.5 \times 8.65$. Answer, 46.4.

107. Find the product of $8.2 \times .45 \times 6.4 \times 16$. Answer, 378.

(Give this test to the student only after he has finished Lesson X or is stopping the work.)

To the student

Here is a chance to try your skill in the use of the slide rule. Read carefully the following instructions:

1. Work the problems straight through, setting down the answers in the column at the extreme right.

2. Fold these answers underneath the paper.

3. Work the problems through again, setting down the answers in the other column.

4. Compare the two sets of answers.

5. If the answers to any problem do not agree (within one point in the third place), work the problem again.

6. Time allowed for the complete work, five minutes. For every two minutes additional, one credit will be deducted.

7. Before starting to work the problems, answer the following questions briefly:

(a) Had you ever used a slide rule before taking these lessons?

(b) How many hours have you spent upon these lessons?

(c) How many of these lessons have you studied?

(d) How far have you progressed in school education? Through ----- grade in common school. Through ----- years in high school. Through ----- years in college.

Test

Credits		Answers, second time	Answers, first time
20	1. 1.28×2.46		
20	2. $84 \div 59.5$		
20	3. $\frac{58.5 \times 15.2}{78}$		
20	4. $6.25 : 24.2 = 9.5 : x$		
20	5. $\sqrt{182}$		

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Unit Course—Farm Mechanics I

WOODWORKING FOR THE GENERAL FARM

February, 1919—Trial edition

PART I. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the man who lives or expects to live on a farm devoted to general farming. No previous experience in woodworking is required, but a common-school education is desirable.

2. THE AIMS OF THE COURSE

The aims of the course are (1) to give a balanced practice in all of the carpentry tool operations involved in farm woodworking; (2) to make as large a number of practical farm necessities of a diversified nature as time will permit; (3) to develop judgment, by actual use, in the selection, use, and care of a kit of woodworking tools for farm use; (4) to become familiar with the various kinds of lumber used for agricultural purposes.

3. LENGTH OF THE COURSE

This course is intended to cover about 30 hours of instruction, study, and practical work by the student. In order to bring the course within this time the instructor will make necessary modifications or substitutions in the problems for construction by the student.

4. OUTLINE OF LESSONS

The following problems, selected because of interest to the general farmer, are suggested for this course. These problems are all worked out in *Agricultural Woodworking*, to which book the pages given refer. The instructor is at liberty, however, to modify the problems or substitute others according to conditions prevailing with the class and student.

1. Nail and staple box.
2. Stepladder.
3. Flat hayrack.
4. Folding bench.
5. Wagon jack.
6. Workbench as on page 85, *Agricultural Woodworking* with homemade vise as on bench in *Industrial Arts Magazine*, January, 1918.

5. GENERAL SUGGESTIONS TO THE TEACHER FOR CONDUCTING THIS WORK

1. Make a list of the tool operations involved in each article to be made and give the class a demonstration of each operation.

2. Give as much individual instruction as possible but never do work for an individual.
 3. See to it that each student gets practice in doing those operations which are hardest for him. This is to counteract the tendency of students doing those operations which they have already mastered just because they are easy.

4. Teach the student to examine cutting tools before beginning work, and if not in perfect cutting order to sharpen them.

5. Demonstrate the proper position to stand at bench for planing and sawing, and also of holding tools. (Observe individuals carefully to see that instructions are understood and carried out.)

6. If circumstances make it possible, have each student measure out his required pieces on the board to be used and saw it out as he will have to do in actual experience on a farm.

Suggestions for the teacher in teaching Lesson 1, Nail and Staple Box.—Bring out the fact that lightness is one desirable essential of the box, and for this reason cypress, redwood, or basswood is preferable to oak, maple, or other hardwood.

2. Bring out the point that the kind of wood to use is in a large measure determined by the section of the country where the box is made; cypress may be available in the South and redwood in the far West, but not the reverse. See "Lumber and Its Uses," Kellog.

3. Point out the method of construction in the box; that good construction requires that the sides and ends project down past the bottom instead of nailing the bottom under the sides and ends.

4. Teach the class kinds of screws and how kinds and sizes are specified and when to use flat-head and when round-head screws.

5. Teach the class the kinds and sizes of nails and how specified. See "Problems in Carpentry," Roehl.

6. In placing flat-head wood screws, holes are bored for screws at least half the length of the screw and the hole countersunk. In hardwood the holes are bored deeper. The screw driver should be held parallel to the screw, so as not to mar the slot in the screw.

7. In driving nails care should be taken not to mar the wood with hammer marks. The nails should be set below the surface with the hammer and nail set.

Suggestions for the teacher in teaching Lesson 2, Stepladder.—1. Demonstrate the method of setting the T bevel by use of the steel square as called for in direction 2.

2. Demonstrate the cutting of a gain for the steps, pointing out particularly that chiseling all way across board will split out the wood and can be prevented by working from both edges toward the center.

3. Point out and demonstrate that a dado can be cut most easily and quickly by making a series of saw cuts as close together as possible; that the stock will not chisel out evenly if only one saw kerf is made at each side of the dado.

4. Refer to Figure 20, page 23, for position to hold chisel.

5. Call attention to the advantage of bringing the strap around the bottom brace as shown in Figure 31.

6. Call attention to other cases of construction where one member is gained into another. See pages 62, 64, 68, 75, 84, 107.

7. Teach the class kinds of hinges, sizes, and how specified. See any hardware catalogue.

8. Give a demonstration of placing the hinge and fastening it in place. The screw which is used in the top part of the hinge on the outside should be of the same diameter as the others but longer—at least $1\frac{1}{2}$ inches—so as to help hold the top brace to the standard.

Suggestions to the teacher in teaching Lesson 3, Flat Hayrack.—1. Tack a piece of scrap lumber temporarily across both ends of the stringers to hold them in position while fastening the cross ties and arms in their positions.

2. Unless the Wenzelmann hayrack clamp is available in the local hardware store, it is advisable to make the homemade clamp so that it will straddle the sill instead of boring through the sill. The ordinary bit is not long enough to reach through the sill and the sill is also considerably weakened by boring two holes through it at each cross arm.

3. It is suggested that a demonstration be given of laying out and cutting a mortise-and-tenon joint and that a student be given two pieces of scrap lumber to practice making the joint before working on the joints used in the standards.

4. Bring out the point that it is necessary that the back standard be easily removed as it can not be in place when the rack is to be used with a hay loader.

5. Emphasize the desirability of clear, straight-grained lumber for the sill and arms, and show samples of desirable and undesirable lumber for such purposes.

6. It is necessary to nail blocks under the sills at points immediately in front and back of the rear axle of the wagon to prevent the rack from sliding back or forward on the wagon.

7. An arrangement should also be provided to prevent the rack from slipping from side to side at front which it might do, owing to the fact that it is not as wide as the space between the wagon stakes. This may be accomplished by use of a false bolster which is composed of three pieces of 2 by 4 inches, one piece as long as the regular bolster with notches at the ends to fit on both sides of the stake, and two pieces of 2 by 4 inches nailed onto the top of the long piece and long enough to fit between the stake and side of the sill. This false bolster is placed on the regular bolster before the rack is placed on the wagon.

Suggestions to the teacher in teaching Lesson 4, Folding Bench.—1. Call attention to the fact that the bench when in use is subjected to continuous wetting and drying and that cypress is a desirable wood to use because it is least affected by moisture or change of moisture content in the wood.

2. Explain the construction of a simple, homemade miter box, and demonstrate its practicability in cutting to length such stock as here used.

3. Teach the students to saw pieces accurately at the ends so that no planing will be required. In doing this have each student test his work with the try square and see where the fault lies. Show him how to apply muscular pressure on the saw to overcome the particular difficulty which is evidenced.

4. It should be noted that the lower crosspieces are not so placed that the braces fit into a perfect square, hence they do not cross at the half-lap joint at a perfect right angle. It is suggested that accurate measurements be taken at the end before the braces are cut to length and the joint laid out.

Suggestions for the teacher in teaching Lesson 5, The Wagon Jack.—1. Call attention of the students to the fact that the plane bit must have a very keen edge to work well in oak. A student should early learn to feel a pride in the condition of his cutting tools. He should sharpen them himself. Enough demonstrations of sharpening should be given to make this possible. Tool sharpening should be considered a very important part of the course.

2. It is very essential that the upper end of the handle work freely between the iron plates. This may be accomplished by making the round end of the handle slightly thinner than the top member of the jack, and when riveting the handle end of the plates placing small pieces of sheet metal between the plate and the handle. The pieces of sheet metal may be removed when the riveting is completed.

3. Call attention to the wagon jacks in problems in "Farm Woodwork," Blackburn, pages 104-105, and point out that the wagon jack No. 2 is designed for heavier work than the No. 1 or the one in "Agricultural Woodworking."

4. Refer to Kellog, "Lumber and Its Uses," page 280, and speak to the class of the great diversity of uses of oak.

Suggestions for the teacher in teaching Lesson 6, Workbench.—1. If the six-student, double workbench is built, the directions as given in the January issue of the Industrial Arts Magazine may be followed explicitly.

2. Call attention of the students to the desirability of having the jaw of the vise work up to the side of the bench in a position parallel to the leg as is done by use of the commercial rapid acting or screw vise or the vise shown in the magazine.

3. It should be noted that if the vise shown in the magazine is used in preference to the one in the book, that the sill or cross rest which is at the vise end should be gained into the leg its full thickness so as to permit the vise braces to project up against the top.

4. Teach the class drawer construction as is usually employed in drawers of this kind. Bring out the point that if no machines or grooving planes are available that very satisfactory drawers may be made employing only plain butt joints for all parts excepting the front which may be constructed as shown with saws and chisel.

5. Refer to the magazine for detail of method of fastening the top.

6. Note that a flush drawer pull is preferable as the others project out and do not permit boards to rest smoothly against the bench.

7. Suggest arrangements whereby the bench may be permanently fastened to a wall. In such case the sill or cross rests may project through and be nailed to studding or wall and the back legs and apron omitted.

8. See Kellog, "Lumber and Its Uses," and make a list of lumber which is available in your locality suitable for a bench.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating be recorded as follows: The average student will be rated "good," the student of exceptional ability will be rated "excellent," while the student of lesser ability will be rated "fair." The student producing work of a quality that would be rejected in the commercial shop, should be rated "poor."

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

1. *Execution of work.*—(a) Time. Is the student rapid, moderate, or slow in executing his work?

(b) Technique. Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

2. *Finished product.*—(a) Accuracy. Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.

(b) Quality. Consider the finished product in other respects than accuracy, such as finish, neatness, etc.

(c) Mastery of principles. Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

3. *Interest.*—(a) Attitude toward work. Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?

(b) Studiousness. Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?

(c) Possibilities of growth. Is the student likely in due time to receive promotion to positions of greater responsibility?

4. *Test problem.*—A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

8. REFERENCE BOOKS FOR TEACHERS

1. Agricultural Woodworking (Roehl). The Bruce Publishing Co., Milwaukee, Wis., 60 cents per copy in quantity.
2. Problems in Carpentry (Roehl). Webb Publishing Co., St. Paul, Minn. \$1 per copy.
3. How to File a Hand Saw. Simons Hardware Co., Fitchburg, Mass. Trade literature free of charge.
4. Disston Handbook on Saws. Henry Disston & Sons Philadelphia, Pa. Trade literature free of charge.
5. Why a Saw Cuts. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.
6. Atkins' Silver Steel Saws. E. C. Atkins & Co., Indianapolis, Ind. Trade literature free of charge.
7. The Steel Square and Its Uses (Radford). The Radford Architectural Co., 178 West Jackson Boulevard, Chicago, Ill. \$1.25.
8. Disston's Saw Chart. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.
9. Lumber and Its Uses (R. S. Kellog). The Radford Architectural Co., Chicago, Ill. \$1.
10. Problems in Farm Woodwork (Samuel Blackburn). The Mannual Arts Press, Peoria, Ill. \$1.
11. Farm Shop Work (Brace and Mayne). American Book Co. (It is suggested that drawings and directions be studied carefully before beginning the construction of any problem.
12. Workbench (homemade, six-student) (Roehl). January issue of the Industrial Arts Magazine. Bruce Publishing Co., Milwaukee, Wis.

8. EQUIPMENT AND MATERIALS

The following list of wood-working equipment is recommended for a general farm. The tools in this list should therefore be provided by the hospital or schoolshop.

1. Individual equipment for group of five students

- 5 hammers, 16-ounce, bell face, adze eyes.
- 5 planes, jack, 14-inch, iron, 2-inch cutter.
- 5 saws, cross cut, 24-inch, 10-inch point.
- 5 squares, try, 8-inch blade, wood handle.
- 5 1-inch iron screws for homemade vise or bench vises (1 for each vise needed).
- 5 bench stops.
- 5 2-foot rules four-fold.
- 5 bench hooks (homemade).

2. General equipment

- 1 set each bits, $\frac{1}{4}$ -inch, $\frac{5}{16}$ -inch, $\frac{3}{8}$ -inch, $\frac{7}{16}$ -inch, $\frac{1}{2}$ -inch, $\frac{5}{8}$ -inch, $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch, 1-inch.
- 2 screw driver bits, $\frac{3}{8}$ -inch and $\frac{5}{16}$ -inch tip.
- 1 countersink, rose.
- 1 bit brace, 8-inch sweep.
- 6 chisels, socket, firmer, $1\frac{1}{4}$ -inch, $1\frac{3}{8}$ -inch, $1\frac{1}{2}$ -inch, $1\frac{5}{8}$ -inch, $1\frac{7}{8}$ -inch, 2-inch.
- 1 dividers, 8-inch, loose leg, wing.
- 1 set twist drills, $\frac{1}{8}$ -inch, $\frac{3}{8}$ -inch by 32ds, straight shank.
- 1 file, mill cut, 6-inch.
- 1 file, mill cut, 10-inch.
- 1 file, slim taper, triangular, 6-inch.
- 1 file, slim taper, 5-inch.
- 1 file, auger bit.
- 1 file, card (cleaner).
- 1 12-inch half-round wood file.
- 1 gauge, marking, plain.

- 1 glass cutter, turret head.
- 1 grindstone, 2 by 24 inches, ball bearing, mounted with foot peda'.
- 1 drawing knife, 8-inch.
- 1 level and plumb, wood, 26-inch.
- 1 mallet.
- 3 nail sets, assorted.
- 1 oil can, $\frac{1}{2}$ -pint.
- 4 wood hand screws (adjustable), 2 to 8 inches, 2 to 12 inches.
- 2 4-foot steel bar carpenter's clamps.
- 1 oilstone, coarse and fine face, carborundum.
- 1 pair pliers.
- 1 punch, center.
- 1 knife, putty.
- 1 saw, rip, 26-inch, 5-point.
- 1 saw-compass, 16-inch.
- 1 saw, hack, 10-inch, with one dozen blades.
- 1 saw, coping, metal handle, with one dozen blades.
- 1 saw, set.
- 1 saw, vise (homemade).
- 1 each screw drivers, 4-inch, 8-inch, and 10-inch.
- 1 square, sliding T bevel, $\frac{1}{8}$ -inch.
- 1 square, steel, 18 by 24 inches, polished, No. 100 rafter framing.
- 1 blacksmith's vise, $3\frac{1}{2}$ -inch jaw.
- 1 10-inch monkey wrench.
- 1 expansion bit, $\frac{3}{4}$ to 3 inches.
- 1 bit brace, 12-inch sweep (ratchet with jaws holding straight shank).
- 1 gouge, $\frac{1}{2}$ -inch, inside firmer.
- 1 hand axe.
- 1 crosscut saw, 4-foot, one or two man.
- 1 crosscut set gauge.
- 1 crosscut saw set.
- 1 plane, fore, 18-inch, iron, 2-inch cutter.
- 2 planes, block, 6-inch, adjustable.
- 1 spokeshave, two cutters—one straight, one curved.

Hardware recommended for this course

This list must be varied according to the number of students and the projects to be constructed.

Nails—

- 10 pounds 4d finishing nails.
- 10 pounds 6d finishing nails.
- 10 pounds 8d finishing nails.
- 10 pounds 10d finishing nails.
- 10 pounds 3d fine common nails.
- 10 pounds 6d fine common nails.
- 10 pounds 8d fine common nails.
- 10 pounds 10d fine common nails.
- 10 pounds 16d fine common nails.
- 10 pounds 20d fine common nails.
- 5 pounds 1-inch brads No. 16.
- 5 pounds $1\frac{1}{4}$ -inch brads No. 16.
- 5 pounds $1\frac{1}{4}$ -inch brads No. 18.
- 1 pound $\frac{3}{4}$ -inch lining nails.

Screws—

(a) Flat-head bright wood screws:

- 1 gross $\frac{3}{4}$ -inch No. 7.
- 1 gross $\frac{7}{8}$ -inch No. 7.
- 1 gross each 1-inch No. 7; 1-inch No. 8.
- 1 gross each $1\frac{1}{4}$ -inch No. 7; $1\frac{1}{4}$ -inch No. 8; $1\frac{1}{4}$ -inch No. 9.
- 1 gross each $1\frac{1}{2}$ -inch No. 8; $1\frac{1}{3}$ -inch No. 9; $1\frac{1}{2}$ -inch No. 10.
- 1 gross each $1\frac{3}{4}$ -inch No. 8; $1\frac{3}{4}$ -inch No. 10; $1\frac{3}{4}$ -inch No. 12.
- 1 gross each 2-inch No. 10; 2-inch No. 12; 2-inch No. 14.
- 1 gross each $2\frac{1}{2}$ -inch No. 10; $2\frac{1}{2}$ -inch No. 12; $2\frac{1}{2}$ -inch No. 14.
- 1 gross 3-inch No. 14.

(b) Round-head blued wood screws:

- 1 gross $\frac{3}{4}$ -inch No. 6.
- 1 gross $1\frac{1}{4}$ -inch No. 10.

Bolts—

Machine bolts:

- 1 package, each of 50, $\frac{3}{8}$ by $2\frac{3}{4}$ inches, $\frac{3}{8}$ by 3 inches, $\frac{3}{8}$ by 4 inches.
- 1 package, each of 50, $\frac{1}{2}$ by 5 inches, $\frac{1}{2}$ by 6 inches, $\frac{1}{2}$ by $6\frac{1}{2}$ inches, $\frac{1}{2}$ by $8\frac{1}{2}$ inches.
- 1 package each of $\frac{1}{2}$ by 9 inches, $\frac{1}{2}$ by 14 inches.

Carriage bolts:

- 1 package each of 50, $\frac{3}{8}$ by 2 inches, $\frac{3}{8}$ by $2\frac{1}{4}$ inches, $\frac{3}{8}$ by 3 inches, $\frac{3}{8}$ by $3\frac{1}{2}$ inches, $\frac{3}{8}$ by 4 inches, $\frac{3}{8}$ by $4\frac{1}{2}$ inches, $\frac{3}{8}$ by 5 inches, $\frac{3}{8}$ by $6\frac{1}{2}$ inches, $\frac{3}{8}$ by 7 inches.
- 1 package each of 100, $\frac{1}{4}$ by $1\frac{1}{2}$ inches, $\frac{1}{4}$ by 2 inches, $\frac{1}{4}$ by $2\frac{1}{2}$ inches, $\frac{1}{4}$ by 3 inches.
- $\frac{1}{4}$ by $3\frac{1}{2}$ inches, $\frac{1}{4}$ by 4 inches, $\frac{1}{4}$ by 5 inches, $\frac{1}{4}$ by $5\frac{1}{2}$ inches.

Thumb nuts, 1 pound.

Washers, 1 pound, $\frac{1}{4}$ -inch.

Nuts, 1 pound, $\frac{1}{4}$ -inch.

Hinges—

- 1 box riveted steel-butt hinges.
- 1 dozen 6-inch light T hinges.
- 1 dozen screw hook and strap hinges for gates.

Rivets—

- 1 pound $\frac{1}{4}$ by $1\frac{3}{4}$ inches, $\frac{1}{4}$ by $3\frac{1}{2}$ inches, $\frac{1}{4}$ by $3\frac{3}{4}$ inches, $\frac{1}{4}$ by $5\frac{1}{4}$ inches.

Poultry-netting staples—

- 1 box, 10 pounds each, $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch, 1-inch.
- Quantity 1-inch mesh chicken wire.
- Quantity of canvas strap for ladders.
- Quantity $\frac{1}{4}$ -inch rod, 20 inches for each milk record sheet case.
- Quantity $\frac{3}{8}$ -inch rod, for fruit ladders and hayrack clamps.

Bill of lumber recommended for this course

This bill of lumber must be varied according to the number of projects to be constructed
 200 feet of $\frac{1}{2}$ -inch lumber, cypress, poplar, soft pine, basswood, red pine, sugar pine, white pine, western white pine, spruce, redwood, or cedar (red), width 10 inches and over, length 12 feet and over.

500 feet of 1-inch lumber, kind same as above, width 10 inches and over, length 12 feet and over.

100 feet of 2 by 6 inch lumber, same as above.

50 feet of 1-inch red oak.

50 feet of 2-inch white oak.

200 feet of 2 by 8 inches by 16 feet, hard pine or cypress.

100 feet of 2 by 4 inches by 16 feet, hard pine or cypress.

100 feet $1\frac{1}{8}$ by 6 inches by 16 feet, hard pine flooring.

200 feet of 2 by 10 inches by 16 feet, yellow pine.

PART II. STUDENTS' INSTRUCTION SHEETS

These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

1. GENERAL INSTRUCTIONS TO STUDENTS

1. Have only necessary tools at your bench.
2. Keep the bench clean of shavings and scrap lumber.
3. Label each piece neatly with pencil and keep them according to some system on the bench when at work.
4. Do not begin the making of a project until you are able to reduce a piece of stock to the dimensions, length, width, and thickness.
5. Have clearly in mind just what you aim to accomplish by each effort.
6. Work carefully and try to attain accuracy. Accuracy at slow rate of work is preferable to the reverse.
7. In using the saws as illustrated in Figures 15 and 16, let the body assume a comfortable position so that you could saw all day without undue strain.
8. When using the plane as in Figure 2, stand with the right hip against the bench and look at the plane from the top and back; not from the side.
9. When learning to square an end or edge, the try-square should be used very often as shown in Figure 6. Try to "sense the feel" of the proper position of the tool.
10. Bear in mind that an assembled object, such as a nail and staple box, stepladder, hayrack, or other articles, which is made up of several pieces, has to have each piece reduced to the dimensions called for in the bill of material or drawing in order that they can fit together into a finished article with a workmanlike appearance. Hence the importance of learning how to reduce a piece of stock to given dimensions accurately.

Lesson I

Problem—Construct a nail and staple box.

- (a) Study drawings and directions on pages 18 and 19 in "Agricultural Woodworking"

In this lesson, the student is expected to learn to reduce stock to required dimensions in length, width, and thickness. Read pages 6 and 7.

Before proceeding with the construction of the box, study the following:

1. Position of holding tools, illustrations pages 7 to 19, inclusive.
2. Method of holding hammer, page 21.
3. Light stroke when starting saw, pages 7 and 13.
4. Setting plane, page 11.
5. Use of bit, page 9.
6. Method of cutting chamfer, page 19.
7. Setting nail with nail set, page 21.

- (b) Construct the box, following carefully the directions on page 19.

- (c) Questions:

1. What is the essential difference between the rip saw and cross-cut saw? See "Why a Saw Cuts," pages 5 and 6.
2. Why hold the plane at a slant as shown in Figures 1 and 2?
3. What is the advantage of using a bench hook?
4. In Figure 10, why feel for the point of the bit?
5. How are sizes of bits designated?
6. What is the advantage of the ratchet in a brace?
7. How are sizes of saws designated? See Atkin's "Silver Steel Saws."
8. How is a plane bit or chisel sharpened? See "Agricultural Woodworking," page 24.

Lesson II

Problem—Construct a stepladder.

(a) Study drawing and directions on pages 54 and 55 in "Agricultural Woodworking."

Before proceeding with construction, study the following points carefully:

1. How to set the T bevel at a desired bevel from the steel square. Direction 2.
2. Difference between chamfer and bevel.
3. Methods of cutting gains and mortises.
4. Kinds of hinges and particular use for each kind.
5. Methods of fastening hinges.
6. Why screws are better than nails for the ladder.
7. Screws—kinds, sizes, and how specified.

(b) Construct the stepladder according to directions given on page 55.

(c) Questions:

1. What are the advantages of a folding ladder over one which is rigid?
2. What is the purpose of gaining the ends of the steps into the standards?
3. In stair building what is meant by the run and rise, and what dimensions of run and rise make an easy stair? See "Steel Square and Its Uses," page 153, also pages 76 and 77, "Problems in Carpentry."

4. Why is the stair placed in the barn on page 122 where it is? What determines the run and rise?

5. What are suitable dimensions for a general farm ladder and a tall fruit ladder? See page 63, "Agricultural Woodworking."

6. What other woods than the one you are using would be desirable for the stepladder? See Kellog, "Lumber and Its Uses," uses of cypress, western white pine, etc.

Lesson III

Problem—Construct a flat hayrack.

(a) Study drawing and directions, pages 82 and 83 of "Agricultural Woodworking."

Special points for study before proceeding with construction:

1. Yellow pine, Kellog.
2. Mortise and tenon joint used in standards.
3. Methods of fastening standards; study detail drawing.
4. Direction 5. Reason for building platform in sections.
5. How to lay out and cut slant on arms.

(b) Construct the hayrack according to directions given on page 83.

(c) Questions:

1. How wide should the hayrack be to be used in the driveway of the barn shown in plan on page 123 of "Agricultural Woodworking"? For the one shown on page 126?

2. What is the maximum width of hayrack that should be used under ordinary conditions?

3. When would you use a basket rack? When a flat rack?

4. Find specimens of each kind of nails: Common, casing, finishing. See "Nails," page 107, "Problems in Carpentry."

5. How are nails usually specified or mentioned as to length? As to size (diameter)?

6. How many nails of each size are there in a pound? How can this be determined without referring to a table of sizes and weights?

7. How many nails would you order to use in 1,000 feet of sheathing? Of clapboards, etc.? "Problems in Carpentry," page 107.

8. What sizes of nails are ordinarily used for given purposes in carpentry? "Problems in Carpentry," page 108.

9. Make out a bill for the nails needed for implement shed shown on page 120 of "Agricultural Woodworking."

10. Which rack is easier to store when not in use, the one on page 82 or the one on page 98, and why?

11. What is the advantage of having the front standard drop down onto the rack, as is the case with the one on page 98?

12. In fastening floor boards, which is the better method, screws or nails, and which is the more expensive?

13. What is the reason for painting a hayrack. How many coats of paint should be used and how much time is required to dry?
14. What other wood may be used for hayracks? See Kellog, "Lumber and Its Uses."
15. Why have a tight floor in a hayrack?
16. How would you store the rack in the implement shed shown on page 120?
17. What advantage is there in driving into a barn with a load of hay on driveways, as shown in the barn on page 125, over unloading hay into barn from the end?

Lesson IV

Problem—Construct a folding bench.

- (a) Study drawing and directions on pages 16 and 17 in "Agricultural Woodworking." Study the following points carefully before starting construction:
 1. Proper method of holding the dividers for swinging an arc, Figure 7, page 9.
 2. Proper method of holding chisel for rounding ends of legs, Figure 8, page 9.
 3. Proper position of holding screw driver in hand, Figure 14, page 13.
 4. Proper method of guiding a saw in starting a saw cut, Figure 15, page 13.
 5. Laying out a half-lap joint.
- (b) Construct the folding bench according to directions on pages 16 and 17.
- (c) Questions:
 1. What are the uses that the bench may be put to on a farm?
 2. What are the advantages of the folding feature of the bench?
 3. How and where would you stand it when not in use?
 4. What dimensions would you change if you wished to use the bench for unusually heavy purposes?
 5. Why is cypress a good wood to use for this purpose? See "Bald Cypress" in Kellog, "Lumber and Its Uses."
 6. Why are flat-head screws preferable to round heads in constructing the bench?
 7. What is the objection to the use of nails in assembling the bench?
 8. What would be the objection to throwing the legs still farther from a vertical position?
 9. Give instances where the bench on page 42 would be better than the one on page 16.
 10. Refer to Kellog, "Lumber and Its Uses," and list the various kinds of lumber suitable for benches.
 11. Where in the various pieces of which the bench is made would a knot be the least objectionable?
 12. Where in a platform member of the bench would a knot be the most objectionable, near the upper or near the lower edge?
 13. Of the lumber available in your locality, which is most free from knots?
 14. In constructing the barn on pages 122–125, where is clear lumber essential and where may knotty lumber be used without marring the strength of the structure? See Kellog, page 65, concerning knots.

Lesson V

Problem—To construct a wagon jack.

- (a) Study drawing and directions on pages 30 and 31 of "Agricultural Woodworking," and pages 104 and 105 in "Problems in Farm Woodworking," Blackburn.
- Before proceeding with the construction, study the following points carefully:
 1. How to cut the wood for the wheel.
 2. Method of laying out the lower end of the main brace.
 3. Method of laying out and removing stock for the end of the main brace to fit into the upper side of the foot.
 4. Rivets and methods of riveting.
 5. How to cut the iron pieces to length and how to center punch for and drill holes.
- (b) Construct the wagon jack according to the drawing and directions on pages 30 and 31.

(c) Questions:

1. Why is a hardwood preferable for a wagon jack?
2. Why are machine bolts better than carriage bolts for this purpose?
3. Enumerate the uses for a wagon jack on a farm.
4. What other agricultural devices require oak or other hardwood? See pages 38 and 39, 66 and 67, 100 and 101; also see Kellog, page 269, "Hickory"; page 277, "Elm"; page 282, "Oak."

Lesson VI

Problem—To construct a workbench.

(a) Study carefully the following before starting the construction of the workbench:

1. Farm shop, homemade workbench. *Industrial Arts Magazine*, January, 1918.
2. Workbench, pages 26 and 27, "Problems in Farm Woodwork," Blackburn.
3. Workbench, pages 138-145. "Farm Shop Work," Brace and Mayne.
4. Carpenter's workbench, pages 84 and 85, "Agricultural Woodworking."
5. Methods of bracing.
6. Methods of fastening top. *Industrial Arts Magazine*.
7. How braces are fastened to legs. *Industrial Arts Magazine*.
8. The two types of homemade vises.
9. Length of bench.
10. Height of bench.

(b) Construct a workbench according to drawings and directions in the *Industrial Arts Magazine* for January, 1918, if the bench is to be used for a group to work at.

Construct a workbench according to directions and drawings on pages 84 and 85, "Agricultural Woodworking," if it is to be used for the farm shop or for only one person to work at.

Questions:

1. What factors determine the length of a bench for a farm shop? See floor plan of farm wood shop, page 89.
2. Why is it preferable to have the front plank of maple?
3. What other hardwood may be substituted for maple?
4. Why is the bench stop shown in the *Industrial Arts Magazine* preferable to the one in "Agricultural Woodworking"?
5. What advantages has the type of vise shown in the *Industrial Arts Magazine* over the one in "Agricultural Woodworking"?
6. What tools or supplies would you keep in the drawer?
7. What would you store on the shelf at the end of the bench?
8. What advantage is it to use one end of the implement shed?
9. What advantage is it to have a farm wood shop as shown on page 88?
10. How would you partition off an end of the implement shed on page 120 for a shop?
11. How would you construct a door so that you could go in and out without rolling open the big door at front?
12. What use may be made of the second floor of the farm shop as shown on pages 88 and 89?
13. Where on the workbench would you place the metal vise?
14. What farm use is there for a metal vise?
15. Why have a stove in the wood shop?
16. What farm tools may be stored in the farm workshop? See pages 91 and 87.
17. What places in a farm building other than a special building for a farm wood shop or the implement shed are suitable for a workbench?
18. What repair work can the average farmer do with such a shop as illustrated on pages 88 and 89?
19. When is it advisable to do repair work on a farm?
20. What farm implements may be drawn into the farm wood shop and overhauled?

Rehabilitation monograph. Joint Series No. 28.

Unit Course—Farm Mechanics II—Woodworking for the Poultry Farm

WOODWORKING FOR THE POULTRY FARM

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the man who lives or expects to live on a farm devoted to poultry farming. No previous experience in woodworking is required, but a common-school education is desirable.

2. THE AIMS OF THE COURSE

1. To give a balanced practice in all of the carpentry tool operations involved in farm woodworking.
2. To make as large a number of practical poultry necessities of a diversified nature as time will permit.
3. To develop judgement, by actual use, in the selection, use, and care of a kit of woodworking tools for farm use.
4. To become familiar with the various kinds of lumber used for agricultural purposes.

3. LENGTH OF THE COURSE

This course is intended to cover about 30 hours of instruction, study, and practical work by the student. In order to bring the course within the specified time, the instructor will make necessary modifications or substitutions in the problems for construction by the student.

4. OUTLINE OF LESSONS

The following problems, selected because of interest to the poultry farmer, are suggested for this course. These problems are all worked out in "Agricultural Woodworking," to which book the pages given refer. The instructor is at liberty, however, to modify the problems or substitute others according to conditions prevailing with the class and student:

- | | |
|----------------------------------|--------------------------|
| 1. Chicken-feed hopper. | 4. Oats sprouter. |
| 2. Chicken brooder coop and run. | 5. Colony poultry house. |
| 3. Trap nest. | |

5. GENERAL SUGGESTIONS TO THE TEACHER FOR CONDUCTING THE WORK

1. Make a list of the tool operations involved in each article to be made and give the class a demonstration of each operation.
2. Give as much individual instruction as possible, but never do work for an individual.
3. See to it that each student gets practice in doing those operations which are hardest for him. This is to counteract the tendency of students doing those operations which they have already mastered just because they are easy.
4. Teach the students to examine cutting tools before beginning work, and if not in perfect cutting order to sharpen them.
5. Demonstrate the proper position to stand at bench for planing and sawing and also of holding tools. Observe individuals carefully to see that instructions are understood and carried out.
6. If circumstances make it possible, have each student measure out his required pieces on the board to be used, and saw it out as he will have to do in actual experience on a farm.

Lesson 1.—Chicken-feed hoppers

1. Bring out the point that the kind of wood to use is in a large measure determined by the section of country where the chicken-feed hopper is made; cypress may be available in the South and redwood in the far West, but not the reverse. (See "Lumber and Its Uses," Kellog.)

2. In driving nails care should be taken not to mar the surface of the wood with hammer marks. Explain the difference between the bell face and plain face hammer in this particular.

3. One of the main points to keep in mind in constructing a poultry-feed hopper of any design is to prevent waste of feed. The hens will flip feed out of a box and waste it unless provision is made to overcome it. One method is to place a piece of 1-inch mesh wire on the feed which allows fowl to eat all there is in the hopper but prevents flipping. Another method is to nail a piece of quarter round or similar strip of wood on the inside of the front piece of the trough at the top. The feed strikes against this and is forced back into the box instead of going over the front and out.

With one or the other of the above arrangements the balance and door may be omitted without marring the efficiency of the hopper.

4. Look up "Chicken-feed box," page 56, Brace and Mayne, and plate 12 in *Problems in Farm Woodwork*, Blackburn.

Lesson 2.—The chicken brooder coop and run

1. Have each student take pieces of scrap lumber and practice making such a joint as is shown in the detail drawing for the corners of the finished job. Bring out the advantage of long, thin finishing nails over common nails in such a place. Call attention to the fact that the corners are very largely held in place by the chicken wire and but little strain is placed on the joint.

2. Both coop and run may be held together at the corners with hooks similar to the method used for holding on the top. Discuss the construction and point out the advantage of such construction to facilitate storage when not in use. All members may then be laid flat on one another.

3. Discuss the advantage of having a coop and run constructed according to some plan over an ordinary dry-goods box or old barrel.

4. Point out that the height of the run may be varied somewhat with different breed of hens, but in all cases should be high enough to permit the hen to stand and walk in a natural position.

5. Study may well be made of laying out the various pieces from a board. The clear part of the board is to be used for the long, narrow pieces, and the knotty part of the board may be used for the floor and side boards.

Lesson 3.—The trap nest

1. In constructing an article such as the trap nest some students are apt to get the idea that it is only crude construction and accuracy of measurement and work is not very important. This must be carefully guarded against, and the student must be made to realize that absolute accuracy of measurement and work are indispensable in the construction of an article to insure workmanlike finished appearance.

2. The construction and successful operation of the trigger depend largely on the ingenuity of the workman. It is suggested that the instructor familiarize himself with said construction and operation by experimentation.

3. There are many kinds of trapping devices in use. It is often advisable to have different devices tried by members of the class and their merits learned by their simplicity of construction and actual operation.

Lesson 4.—The oats sprouter

1. Call attention to the fact that lumber is sawed to the dimensions which it is specified by at the yard, but when it is "dressed all round"—that is, planed on both sides and edges—it is reduced below specified dimensions; so that what is called a 2 by 4 is only about $1\frac{3}{4}$ by $3\frac{3}{4}$ inches, and in many instances even smaller.

2. In any framing work the lumber is usually left as it comes from the lumber yard, as far as thickness and width are concerned. It is suggested that the framework of the oats sprouter be built of lumber just as it comes from the yard; that is, dressed all round.

3. The bottom of the flats may be constructed of narrower pieces and drainage brought about by leaving $\frac{1}{4}$ -inch spaces between the strips.

4. Point out that the ends and sides of the flats must project down over the bottom for good construction.

5. Point out that a poor grade of lumber is quite as serviceable as a high grade in such a problem as this, and its use is therefore permissible and even advisable.

6. MEASURING, RATING, AND RECORDING STUDENTS' WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course, as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

1. *Execution of work*

(a) *Time*.—Is the student rapid, moderate, or slow in executing his work?

(b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

2. *Finished product*

(a) *Accuracy*.—Should be determined by the record kept of errors in measurements, omissions of dimensions or lines, etc.

(b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.

(c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

3. *Interest*

(a) *Attitude toward work*.—Does the student love his work, or does he watch the clock? Is he likely to continue in this line of work?

(b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?

(c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

4. *Test problem*

A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

7. REFERENCE BOOKS FOR TEACHERS

1. Agricultural Woodworking. Roehl. The Bruce Publishing Co., Milwaukee, Wis. \$0.60 per copy in quantity.
2. Problems in Carpentry. Roehl. Webb Publishing Co., St. Paul, Minn. \$1 per copy.
3. How to File a Hand Saw. Simons Hardware Co., Fitchburg, Mass. Trade literature free of charge.
4. Disston Handbook on Saws. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.
5. Why a Saw Cuts. Henry Disston & Sons., Philadelphia, Pa. Trade literature free of charge.
6. Atkin's Silver Steel Saws. E. C. Atkins & Co., Indianapolis, Ind. Trade literature free of charge.
7. The Steel Square and Its Uses. Radford. The Radford Architectural Co., 178 West Jackson Boulevard, Chicago, Ill. \$1.25.
8. Disston's Saw Chart. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.
9. Lumber and Its Uses. R. S. Kellog. The Radford Architectural Co., Chicago, Ill. \$1.
10. Problems in Farm Woodwork. The Manual Arts Press, Peoria, Ill. Samuel Blackburn.
11. Farm Shop Work. American Book Co. Brace and Mayne. (It is suggested that drawings and directions be studied carefully before beginning the construction of any problem.)
12. Workbench (Home-made, Six-Student). January Issue of The Industrial Arts Magazine. The Bruce Publishing Co., Milwaukee, Wis. Roehl.

8. EQUIPMENT AND MATERIALS

The following list of woodworking equipment is recommended for a poultry farm. The tools in this list should therefore be provided by the hospital or school shop:

1. *Individual equipment for group of five students*

- 5 hammers, 16-ounce, bell face, adze eyes.
- 5 planes, jack, 14-inch, iron, 2-inch cutter.
- 5 saws, crosscut, 24-inch, 10-inch point.
- 5 squares, try, 8-inch blade, wood handle.
- 5 1-inch iron screws for home-made vises or bench vises (1 for each vise needed).
- 5 bench stops.
- 5 2-foot rules, four-fold.
- 5 bench hooks (home made).

2. *General equipment*

- 1 set each bits, $\frac{1}{4}$ -inch, $\frac{5}{16}$ -inch, $\frac{3}{8}$ -inch, $\frac{7}{16}$ -inch, $\frac{1}{2}$ -inch, $\frac{5}{8}$ -inch, $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch, 1-inch.
- 2 screw-driver bits, $\frac{3}{8}$ -inch and $\frac{5}{16}$ -inch tip.
- 1 countersink, rose.
- 1 bit brace, 8-inch sweep.
- 6 chisels, socket, firmer, $1\frac{1}{4}$ -inch, $1\frac{3}{8}$ -inch, $1\frac{1}{2}$ -inch, $1\frac{5}{8}$ -inch, $1\frac{7}{8}$ -inch, 2-inch.
- 1 dividers, 8-inch, loose leg, wing.
- 1 set twist drills, $\frac{1}{8}$ -inch to $\frac{3}{8}$ -inch by 32ds, straight shank.
- 1 file, mill cut, 6-inch.
- 1 file, mill cut, 10-inch.

- 1 file, slim taper, triangular, 6-inch.
- 1 file, slim taper, 5-inch.
- 1 file, auger bit.
- 1 file, card (cleaner).
- 1 12-inch half-round wood file.
- 1 guage, marking, plain.
- 1 glass cutter, turret head.
- 1 grindstone, 2 by 24 inches, ball-bearing, mounted with foot pedal.
- 1 drawing knife, 8-inch.
- 1 level and plumb, wood, 26-inch.
- 1 mallet.
- 3 nail sets, assorted.
- 1 oil can, $\frac{1}{2}$ -pint.
- 4 wood hand screws (adjustable), two 8-inch, two 12-inch.
- 2 4-foot steel-bar carpenter's clamps.
- 1 oilstone, coarse and fine face carborundum.
- 1 pair pliers.
- 1 punch, center.
- 1 putty knife.
- 1 saw, rip, 26-inch, 5-point.
- 1 saw, compass, 16-inch.
- 1 saw, hack, 10-inch, with one dozen blades.
- 1 saw, coping, metal handle, with one dozen blades.
- 1 saw set.
- 1 saw, vise (homemade).
- 1 each screw drivers, 4-inch, 8-inch, and 10-inch.
- 1 square, sliding T bevel, $\frac{1}{8}$ -inch.
- 1 square, steel, 18 by 24 inches, polished, No. 100 rafter framing.
- 1 blacksmith's vise, $3\frac{1}{2}$ -inch jaw.
- 1 10-inch monkey wrench.
- 1 expansion bit $\frac{3}{4}$ to 3 inches.
- 1 bit brace, 12-inch sweep (ratchet with jaws holding straight shank drills).
- 1 gouge, $\frac{1}{2}$ -inch, inside firmer.
- 1 hand ax.
- 1 crosscut saw, 4-foot, one or two man.
- 1 crosscut set guage.
- 1 crosscut set.
- 1 plane fore, 18-inch iron, 2-inch cutter.
- 2 planes, block, 6-inch, adjustable.
- 1 spoke shave, 2 cutters, 1 straight, 1 curved.
- 1 breast drill and set of drills.

Bill of hardware for this course

The instructor should modify this list to suit the number of students and the projects to be constructed.

Nails:

- 10 pounds fourpenny finishing nails.
- 10 pounds sixpenny finishing nails.
- 10 pounds fivepenny finishing nails.
- 10 pounds tenpenny finishing nails.
- 10 pounds threepenny fine common nails.
- 10 pounds sixpenny fine common nails.
- 10 pounds eightpenny fine common nails.
- 10 pounds tenpenny fine common nails.
- 10 pounds sixteenpenny fine common nails.
- 10 pounds twenty penny fine common nails.

Nails—Continued.

- 5 pounds 1-inch brads No. 16.
- 5 pounds $1\frac{1}{4}$ -inch brads No. 16.
- 5 pounds $1\frac{1}{4}$ -inch brads No. 18.
- 1 pound $\frac{1}{4}$ -inch lining nails.

Screws:

(a) Flathead bright wood screws—

- 1 gross $\frac{3}{4}$ -inch No. 7.
- 1 gross $\frac{7}{8}$ -inch No. 7.
- 1 gross each 1-inch No. 7, 1-inch No. 8.
- 1 gross each $1\frac{1}{4}$ -inch No. 7, $1\frac{1}{4}$ -inch No. 8, $1\frac{1}{4}$ -inch No. 9.
- 1 gross each $1\frac{1}{2}$ -inch No. 8, $1\frac{1}{2}$ -inch No. 9, $1\frac{1}{4}$ -inch No. 10.
- 1 gross each $1\frac{3}{4}$ -inch No. 8, $1\frac{3}{4}$ -inch No. 10, $1\frac{3}{4}$ -inch No. 12.
- 1 gross each 2-inch No. 10, 2-inch No. 12, 2-inch No. 14.
- 1 gross each $2\frac{1}{2}$ -inch No. 10, $2\frac{1}{2}$ -inch No. 12, $2\frac{1}{2}$ -inch No. 14.
- 1 gross 3-inch No. 14.

(b) Roundhead blued wood screws—

- 1 gross $\frac{3}{4}$ -inch No. 6.
- 1 gross $1\frac{1}{4}$ -inch No. 10.

Bolts:

Machine bolts—

- 1 package each of 50— $\frac{3}{8}$ by $2\frac{3}{4}$ inches, $\frac{3}{8}$ by 3 inches, $\frac{3}{8}$ by 4 inches, $\frac{1}{2}$ by 5 inches, $\frac{1}{2}$ by 6 inches, $\frac{1}{2}$ by $6\frac{1}{2}$ inches, $\frac{1}{2}$ by $8\frac{1}{2}$ inches, $\frac{1}{2}$ by 9 inches, $\frac{1}{2}$ by 14 inches.

Carriage bolts—

- 1 package each of 50— $\frac{3}{8}$ by 2 inches, $\frac{3}{8}$ by $2\frac{1}{4}$ inches, $\frac{3}{8}$ by 3 inches, $\frac{3}{8}$ by $3\frac{1}{2}$ inches, $\frac{3}{8}$ by 4 inches, $\frac{3}{8}$ by $4\frac{1}{2}$ inches, $\frac{3}{8}$ by 5 inches, $\frac{3}{8}$ by $6\frac{1}{2}$ inches, $\frac{3}{8}$ by 7 inches.
- 1 package each of 100— $\frac{1}{4}$ by $1\frac{1}{2}$ inches, $\frac{1}{4}$ by 2 inches, $\frac{1}{4}$ by $2\frac{1}{2}$ inches, $\frac{1}{4}$ by 3 inches, $\frac{1}{4}$ by $3\frac{1}{2}$ inches, $\frac{1}{4}$ by 4 inches, $\frac{1}{4}$ by 5 inches, $\frac{1}{4}$ by $5\frac{1}{2}$ inches.

Thumbnuts, 1 pound.

Washers, 1 pound, $\frac{1}{4}$ -inch.Nuts, 1 pound, $\frac{1}{4}$ -inch.

Hinges:

- 1 box riveted steel butt hinges.
- 1 dozen 6-inch light T hinges.
- 1 dozen screw hook and strap hinges for gates.

Rivets, 1 pound— $\frac{1}{4}$ by $1\frac{3}{4}$ inches, $\frac{1}{4}$ by $3\frac{1}{2}$ inches, $\frac{1}{4}$ by $3\frac{3}{4}$ inches, $\frac{1}{4}$ by $5\frac{1}{4}$ inches.Poultry netting staples, 1 box of 10 pounds, each, $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch, 1-inch.

Quantity 1-inch mesh chicken wire.

Quantity of canvas strap for ladders.

Quantity $\frac{1}{4}$ -inch rod, 20 inches for each milk record sheet case.Quantity $\frac{3}{8}$ -inch rod, for fruit ladders and hayrack clamps.*Bill of lumber for this course*

The instructor must modify this list to suit the particular plans for his group of students.

200 feet of $\frac{1}{2}$ -inch lumber, cypress, poplar, soft pine, basswood, red pine, sugar pine, white pine, western white pine, spruce, redwood, or cedar (red); width 10 inches and over, length 12 feet and over.

500 feet of 1-inch lumber, kind, same as above, width 10 inches and over, length 12 feet and over.

100 feet of 2 by 6 inch lumber, same as above.

50 feet of 1-inch red oak.

50 feet of 2-inch white oak.

200 feet 2 by 8 by 16 inch hard pine or cypress.

100 feet 2 by 4 by 16 inch hard pine or cypress.

100 feet $\frac{1}{2}$ by 6 by 16 inch hard pine flooring.

200 feet 2 by 10 by 16 inch yellow pine.

PART 2. STUDENTS' INSTRUCTION SHEETS

These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS TO STUDENTS

1. Have only necessary tools at your bench.
2. Keep the bench clean of shavings and scrap lumber.
3. Label each piece neatly with pencil and keep them according to some system on the bench when at work.
4. Don't begin the making of a project until you are able to reduce a piece of stock to the dimensions, length, width, and thickness.
5. Have clearly in mind just what you aim to accomplish by each effort.
6. Work carefully and try to attain accuracy. Accuracy at slow rate of work is preferable to the reverse.
7. In using the saws as illustrated in figures 15 and 16 let the body assume a comfortable position, so that you could saw all day without undue strain.
8. When using the plane as in figure 2 stand with the right hip against the bench and look at the plane from the top and back; not from the side.
9. When learning to square an end or edge the try square should be used very often, as shown in figure 6. Try to "sense the feel" of the proper position of the tool.
10. Bear in mind that an assembled object, such as will be made in this course, which is made up of several pieces, has to have each piece reduced to the dimensions called for in the bill of material or drawing, in order that they can fit together into a finished article with a workmanlike appearance. Hence the importance of learning at the beginning how to reduce a piece of stock to given dimensions accurately.

Lesson I.—Problem: Construct a chicken-feed hopper

(Pages 34-35, Agricultural Woodworking)

A. In this lesson the student is expected to learn to reduce stock to required dimensions in length, width, and thickness. Read and study pages 6, 7.

Before beginning with the construction of the box, study the following:

1. Position of holding tools. See illustrations, pages 7 to 19, inclusive.
2. Method of holding hammer, page 21.
3. Light stroke when starting saw, pages 7 and 13.
4. Setting plane, page 11.
5. Position to hold wood on a saw horse, figures 15 and 16.

B. Construct the chicken-feed hopper, following the drawing and directions on pages 34 and 35.

C. Questions:

1. What is the advantage of using a bench hook? (See fig. 4.)
2. Why hold the plane on a slant as shown in figure 2?
3. What is the essential difference between a ripsaw and a crosscut saw? (See *Why a Saw Cuts*, pp. 5, 6.)
4. How are sizes of saws designated? (See *Atkins Silver Steel Saws*.)
5. How is a plane, bit, or chisel sharpened? (See *Agricultural Woodworking* p. 24.)
6. How are nails specified as to kind, size, and length? (See *Problems in Carpentry*, p. 107.)
7. How many nails are there of each kind to a pound? (See *Problems in Carpentry*, p. 107.)
8. How many nails would you order to use for 1,000 feet of sheathing, etc? (See *Problems in Carpentry*, p. 107.)
9. What sizes and kinds of nails are usually used for given purposes in carpentry? (See *Problems in Carpentry*, p. 108.)

10. Enumerate the various kinds and sizes of hinges and tell why the T hinge is preferable here.

11. What arrangement can you suggest for fastening the hopper to the wall?

Lesson II.—Problem: To construct a chicken brooder coop and run

A. Study drawing and directions on pages 49, 50, 51, and pages 36, 37, Agricultural Woodworking, also plate 11 in Problems in Farm Woodwork, Blackburn.

Study carefully the following points before beginning the construction of the one on pages 49, 50, 51.

1. Method of construction of top and bottom of coop so as to be removable.
2. Method of assembling post, side, and end of run as shown in detail drawings.
3. How to fasten in place the wire door which is at the side of the run.

B. Construct a chicken brooder coop and run according to drawing and directions on pages 49, 50, 51.

C. Questions.

1. What is the advantage of a removable bottom?
2. What use would you make of the fact that the top of the coop is removable?
3. What method can you suggest for fastening the run to the coop so as to make it more easily removable for storage when not in use?
4. Why have a screen over the door at front?
5. Where would you place a brace between the sides of the run at top to prevent the wire from drawing them together? How would you fasten the brace to the side members? Would you place it flat or on edge?
6. Why are finishing nails suggested for assembling the run at corners?
7. Where about a farmstead would you store the coop when not in use?

Lesson III.—Problem: Construct a trap nest

A. Study the drawing and directions of pages 58 and 59 in Agricultural Woodworking; plate 10 in Problems in Farm Woodwork; pages 61–65 in Farm Shop Work, by Brace and Mayne.

Study carefully the following points before beginning the construction:

1. Position in the box of each piece listed in the stock bill.
 2. How the angle iron which is shown in the detail drawing is fastened to the top of the doors.
 3. Detail of the trigger construction.
 4. Note the position of the nail which prevents the door from being forced out.
- B. Construct a trap nest according to the drawing and directions on pages 58 and 59 in Agricultural Woodworking.

C. Questions:

1. What is the reason for using a trap nest?
2. Why is oak, maple, or other hardwood preferable to pine, basswood, or other softwood for the trigger?
3. Why use one-half-inch lumber for the doors?
4. Note that the ends, floor, and partition are made of two pieces 9 inches wide. Wouldn't pieces of other dimensions do just as well?
5. What would you suggest as a means of preventing fowl from roosting on the top of the box?
6. Is it necessary that clear lumber be used for the trap nest?
7. In cutting the door would you have the grain of the wood run horizontally or vertically? Why?
8. Should the trap nest rest on the floor of the poultry house or should it be fastened up against the wall?
9. How high would you place it and how would you fasten it?
10. If you wish greater trap-nest facilities, would you build a number of nests to the dimensions of this one, or would you build one long nest?

Lesson IV.—Problem: Construct an oats sprouter

A. Study drawing and directions, pages 75–76–77 in *Agricultural Woodworking*. Study carefully the following points before beginning the construction:

1. That the framework is constructed of the common 2 by 4 inch lumber.
2. That the crossbars are gained into the posts one-fourth inch.
3. Study direction 4, which explains how to use the steel square for laying out 45° cuts.

In rafter framing the figures 12 and 12 are usually used for the rafters of a one-half-inch pitch roof. See page 54, *Problems in Carpentry*.

4. Note that the bottoms of the flats are set up instead of being nailed on to the bottom edges of the sides and ends.

B. Construct an oats sprouter according to the drawing and directions on pages 75, 76, 77 in *Agricultural Woodworking*.

C. Questions:

1. Why is cypress the most desirable lumber for flats? (See *Cypress and its Uses*, Kellog.)
2. What is the actual width and thickness of the lumber called 2 by 4 inches as found in the ordinary lumber yard?
3. What is the reason for setting the crossbars into the posts?
4. What grades of lumber would you recommend for the oats sprouter?
5. The stock bill calls for two pieces 7½ inches wide for the bottom of each flat. Is it necessary that the bottom be of two pieces only, or may it be made of any available widths?
6. Why bore holes in the bottom of the flats, as shown in the detail drawing?
7. Why is it very essential that the framework be perfectly square?
8. Where about the ordinary farmstead would you suggest keeping the oats sprouter when in use?

Lesson V.—Problem: Construct a colony poultry house

The colony poultry house is suggested as a class problem, though it is a problem which one man can readily build.

A. Study carefully the drawing and bill of material on pages 115, 116, of *Agricultural Woodworking*. Find on the drawing the various members listed in the bill of material, i. e., skids, joists, studding, rafters, sole piece, door casing, etc.

1. Cut the skids and crossties to length, cut the ends of the skids at bottom as shown in the front view, cut gains into the top edges of the skids to receive the crossties and bolt them firmly together with one ½ by 6½ inch carriage bolt at each joint. The skids should be placed on a floor or piece of level ground, as they become the foundation on which to construct the building.

2. There are seven joists; place them on the skids on edge, space them at equal distances on center, and toenail them to the skids.

3. Lay the floor so that it covers the entire floor space 8 by 12 feet.

4. Lay pieces of 2 by 4 inch flat on the floor at the outer edge all around and securely spike to the floor at the joists. This member is called the sole piece.

5. Study the floor plan carefully for placing the studding. For larger buildings studding is doubled at corners and at sides of doors and windows. In a small building, such as this doubling is unnecessary.

6. To place the studding for the windows it is necessary to find the over-all width of the sash and two window jambs plus at least one-half inch for getting the window plumb. The studdings are toenailed to the sole piece with sixteen-penny common nails from both sides.

7. It may be noted in the cross-section drawing that girts are placed between studding above and below the windows; these are fastened with sixteenpenny nails to the studding at either side.

8. There are seven rafters, spaced the same as the joists. It may be noted in the cross section that the rafters project the width of the plancher plus the thickness of the drop siding. The rafters are toenailed to plate from each side.

9. The window and door frames are placed in position, and the drop siding is cut to butt against the frame at each side.

10. The kind of lumber to use for roof boards depends on the roof covering. If shingles are to be used, common boards may be used, and the joints need not be tight. If roofing paper is used, matched and dressed lumber must be used, so that the roofing paper will lay flat and smooth. The roof boards should be nailed on before the drop siding, so that the siding when placed may be made to fit up tight against the roof or lookout blocks. The roof boards should be cut to a straight edge, so that the roofing paper can be tacked evenly over the edge. See Problems in Carpentry, pages 82, 83, 95, for method of nailing lookout blocks.

11. Note in the floor plan that the door jamb is nailed to the studding and comes out flush with the outside of the drop siding. The door casings are then set back to the center of the jamb, which brings the door flush with the casing. This permits the door to be fastened with hinges on the outside and the door in closing to slam up against the edge of the jamb. It may be noted in the picture on page 115 that the door has two straps and a diagonal brace. The brace is essential to keep the door from sagging at the edge opposite the hinges.

12. Corner boards are usually nailed together into trough shape and then fastened in place instead of nailing piece at a time.

13. The windows are hinged at top so as to swing out and should be provided with a hook and screw eye at inside at bottom, so they may be fastened when shut.

14. The house is finished with two coats of paint. The first coat should have several days to dry before the second coat is applied.

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Unit Course—Farm Mechanics III—Woodworking for the Dairy Farm

WOODWORKING FOR THE DAIRY FARM

February, 1919—Trial edition

PART I. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the man who lives or expects to live on a farm devoted to dairy farming. No previous experience in woodworking is required, but a common school education is desirable.

2. THE AIMS OF THE COURSE

1. To give a balanced practice in all of the carpentry tool operations involved in wood-working for the dairy farm.

2. To make as large a number of practical farm necessities for the particular use of the dairy farm as time will permit.

3. To develop judgment, by actual use, in the selection, use, and care of a kit of wood-working tools for farm use.

4. To become familiar with the various kinds of lumber used for agricultural purposes.

3. LENGTH OF THE COURSE

This course is intended to cover about 30 hours of instruction, study, and practical work by the student. In order to bring the course within this time, the instructor will make necessary modifications or substitutions in the problems for construction by the student.

4. OUTLINE OF LESSONS

The following problems, selected because of interest to the dairy farmer, are suggested for this course. These problems are all worked out in "Agricultural Woodworking," to which book the pages given refer. The instructor is at liberty, however, to modify the problems or substitute others according to conditions prevailing with the class and student.

1. Folding bench.
2. Milk record sheet case.
3. Hay rack.
4. Silo form.
5. Dairy barn.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

1. Execution of work

- (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
- (b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

2. Finished product

- (a) *Accuracy*.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.
- (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

3. Interest

- (a) *Attitude toward work*.—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?
- (b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?
- (c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

4. Test problem

A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

6. GENERAL SUGGESTIONS TO THE TEACHER FOR CONDUCTING THE WORK

1. Make a list of the tool operations involved in each article to be made and give the class a demonstration of each operation.
2. Give as much individual instruction as possible but never do work for an individual.
3. See to it that each student gets practice in doing those operations which are hardest for him. This is to counteract the tendency of students doing those operations which they have already mastered just because they are easy.
4. Teach the students to examine cutting tools before beginning work and if not in perfect cutting order, to sharpen them.
5. Demonstrate the proper position to stand at bench for planing and sawing and also of holding tools, and observe individuals carefully to see that instructions are understood and carried out.
6. If circumstances make it possible, have each student measure out his required pieces on the board to be used and saw it out as he will have to do in actual experience on a farm.

Lesson I.—The folding bench

1. Call attention to the fact that the bench when in use is subjected to continuous wetting and drying, and that cypress is a desirable wood to use, because it is least affected by moisture or change of moisture content in the wood.
2. Explain the construction of a single, homemade miter box, and demonstrate its practicability in cutting to length such stock as here used.
3. Teach the students to saw pieces accurately at the ends so that no planing will be required. In doing this, have each student test his work with the try-square and see where the fault lies. Show him how to apply muscular pressure on the saw to overcome the particular difficulty which is evidenced.
4. It should be noted that the lower crosspieces are not so placed that the braces fit into a perfect square, hence they do not cross at the half-lap joint at a perfect angle. It is suggested that accurate measurements be taken at the end before the braces are cut to length and the joint laid out.

Lesson II.—The daily milk record sheet case

1. Secure perfectly clear lumber if possible.
2. Read direction 7. Bend the $\frac{1}{4}$ -inch of a $16\frac{1}{8}$ -inch edge before bending the sheet into the cylindrical form shown in the detail drawing.
3. The fourpenny finishing nails may be too thick for such wood as is available for your shop and brads may serve better for assembling the box.
4. Point out the difference in cleavability of different woods, that some woods take nails without splitting much better than others.
5. Be sure and lock the cylinders securely onto the rod by means of the nuts and washers.
6. If not familiar with use of sheet metal, secure small pieces and bend to desired forms previous to bending the big pieces.
7. Make a milk record sheet and insert it into a completed box to show it complete.

Lesson III.—The flat hayrack

1. Tack a piece of scrap lumber temporarily across both ends of the stringers to hold them in position while fastening the crossties and arms in their positions.
2. Unless the Wenzelmann hayrack clamp is available in the local hardware store, it is advisable to make the homemade clamp so that it will straddle the sill instead of boring through the sill. The ordinary bit is not long enough to reach through the sill and the sill is also considerably weakened by boring two holes through it at each cross arm.
3. It is suggested that a demonstration be given of laying out and cutting a mortise and tenon joint and that a student be given two pieces of scrap lumber to practice making the joint before working on the joints used in the standards.
4. Bring out the point that it is necessary that the back standard is easily removed, as it can not be in place when the rack is to be used with a hay loader.

5. Emphasize the desirability of clear, straight-grained lumber for the sill and arms and show samples of desirable and undesirable lumber for such purposes.

6. It is necessary to nail blocks under the sills at points immediately in front and back of the rear axle of the wagon to prevent the rack from sliding back or forward on the wagon.

7. An arrangement should also be provided to prevent the rack from slipping from side to side at front which it might do, owing to the fact that it is not as wide as the space between the wagon stakes. This may be accomplished by use of a false bolster, which is composed of three pieces of 2 by 4 inches, one piece as long as the regular bolster with notches at the ends to fit on both sides of the stake, and two pieces of 2 by 4 inches nailed to the top of the long pieces and long enough to fit between the stake and side of the sill. This false bolster is placed onto the regular bolster before the rack is placed on the wagon.

7. REFERENCE BOOKS FOR TEACHERS

1. Agricultural Woodworking. Roehl. Bruce Publishing Co., Milwaukee, Wis. \$0.60 per copy in quantity.

2. Problems in Carpentry. Roehl. Webb Publishing Co., St. Paul, Minn. \$1 per copy.

3. How to File a Hand Saw. Simons Hardware Co., Fitchburg, Mass. Trade literature free of charge.

4. Disston Handbook on Saws. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.

5. Why a Saw Cuts. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.

6. Atkins' Silver Steel Saws. E. C. Atkins & Co., Indianapolis, Ind. Trade literature free of charge.

7. The Steel Square and Its Uses. Radford. Radford Architectural Co., 178 West Jackson Boulevard, Chicago, Ill. \$1.25.

8. Disston's Saw Chart. Henry Disston & Sons, Philadelphia, Pa. Trade literature free of charge.

9. Lumber and Its Uses. R. S. Kellog. Radford Architectural Co., Chicago, Ill. \$1.

10. Problems in Farm Woodwork. Samuel Blackburn. Manual Arts Press, Peoria, Ill.

11. Farm Shop Work. Brace and Mayne. American Book Co. (It is suggested that drawings and directions be studied carefully before beginning the construction of any problem.)

12. Workbench (homemade, six student). Roehl. January issue of Industrial Arts Magazine, Bruce Publishing Co., Milwaukee, Wis.

8. EQUIPMENT AND MATERIALS

The following list of woodworking equipment is recommended for a general farm. The tools in this list should therefore be provided by the hospital or school shop.

1. Individual equipment for group of five students

5 hammers, 16-ounce, bell face, adz eyes.

5 planes, jack, 14-inch, iron, 2-inch cutter.

5 saws, crosscut, 24-inch, 10-inch point.

5 try-squares, 8-inch blade, wood handle.

5 iron screws, 1-inch for homemade vises or bench vises (1 for each vise needed).

5 bench stops.

5 rules, 2-foot, four fold.

5 bench hooks (homemade).

2. General equipment

1 set each, bits, $\frac{1}{4}$ -inch, $\frac{5}{16}$ -inch, $\frac{3}{8}$ -inch, $\frac{7}{16}$ -inch, $\frac{1}{2}$ -inch, $\frac{5}{8}$ -inch, $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch, 1-inch.

2 screw-driver bits, $\frac{3}{8}$ -inch and $\frac{5}{16}$ -inch tip.

1 countersink, rose.

1 bit brace, 8-inch sweep.

- 6 chisels, socket, firmer, $1\frac{1}{4}$ -inch, $1\frac{3}{8}$ -inch, $1\frac{1}{2}$ -inch, $1\frac{5}{8}$ -inch, $1\frac{7}{8}$ -inch, 2-inch.
- 1 dividers, 8-inch, loose leg, wing.
- 1 set twist drills, $\frac{1}{8}$ to $\frac{3}{8}$ inch by 32ds, straight shank.
- 1 file, mill cut, 6-inch.
- 1 file, mill cut, 10-inch.
- 1 file, slim taper, triangular, 6-inch.
- 1 file, slim taper, 5-inch.
- 1 file, auger bit.
- 1 file card (cleaner).
- 1 half-round wood file, 12-inch.
- 1 gauge, marking, plain.
- 1 glass cutter, turret head.
- 1 grindstone, 2 by 24 inch, ball bearing, mounted with foot pedal.
- 1 drawing knife, 8-inch.
- 1 level and plumb, wood, 26-inch.
- 1 mallet.
- 3 nail sets, assorted.
- 1 oil can, $\frac{1}{2}$ pint.
- 4 wood hand screws (adjustable), two 8-inch, two 12-inch.
- 2 4-foot steel-bar carpenter's clamps.
- 1 oilstone, coarse and fine face carborundum.
- 1 pair pliers.
- 1 punch, center.
- 1 putty knife.
- 1 saw, rip, 26-inch, 5 point.
- 1 saw, compass, 16-inch.
- 1 saw, hack, 10-inch, with one dozen blades.
- 1 saw, coping, metal handle, with one dozen blades.
- 1 saw, set.
- 1 saw, vise (homemade).
- 1 each, screw drivers, 4-inch, 8-inch, and 10-inch.
- 1 square, sliding T-bevel, 1 to 8 inch.
- 1 square, steel, 18 by 24 inch, polished, No. 100 rafter framing.
- 1 blacksmith's vise, $3\frac{1}{2}$ -inch jaw.
- 1 monkey wrench, 10-inch.
- 1 expansion bit, $\frac{3}{4}$ to 3 inch.
- 1 bit brace, 12-inch sweep. (Ratchet with jaws holding straight shank.)
- 1 gouge, $\frac{1}{2}$ -inch, inside firmer.
- 1 hand ax.
- 1 crosscut saw, 4-foot, one or two man.
- 1 crosscut set gauge.
- 1 crosscut saw set.
- 1 plane, fore, 18-inch, iron, 2-inch cutter.
- 2 planes, block, 6-inch, adjustable.
- 1 spoke shave, two cutters, 1 straight, 1 curved.
- 1 breast drill and set of drills.

3. Bill of hardware for this course

The instructor must modify this list according to the number of students and the projects to be constructed.

Nails:

- 10 pounds fourpenny finishing nails.
- 10 pounds sixpenny finishing nails.
- 10 pounds eightpenny finishing nails.
- 10 pounds tenpenny finishing nails.
- 10 pounds threepenny fine common nails.

Nails—Continued.

- 10 pounds sixpenny fine common nails.
- 10 pounds eightpenny fine common nails.
- 10 pounds tenpenny fine common nails.
- 10 pounds sixteenpenny fine common nails.
- 10 pounds twentypenny fine common nails.
- 5 pounds 1-inch brads No. 16.
- 5 pounds $1\frac{1}{4}$ -inch brads No. 16.
- 5 pounds $1\frac{1}{4}$ -inch brads No. 18.
- 1 pound $\frac{3}{4}$ -inch lining nails.

Screws:

A—flathead bright wood screws.

- 1 gross $\frac{3}{4}$ -inch No. 7.
- 1 gross $\frac{7}{8}$ -inch No. 7.
- 1 gross each 1-inch No. 7, 1-inch No. 8.
- 1 gross each $1\frac{1}{4}$ -inch No. 7, $1\frac{1}{4}$ -inch No. 8, $1\frac{1}{4}$ -inch No. 9.
- 1 gross each $1\frac{1}{2}$ -inch No. 8, $1\frac{1}{2}$ -inch No. 9, $1\frac{1}{2}$ -inch No. 10.
- 1 gross each $1\frac{3}{4}$ -inch No. 8, $1\frac{3}{4}$ -inch No. 10, $1\frac{3}{4}$ -inch No. 12.
- 1 gross each 2-inch No. 10, 2-inch No. 12, 2-inch No. 14.
- 1 gross each $2\frac{1}{2}$ -inch No. 10, $2\frac{1}{2}$ -inch No. 12, $2\frac{1}{2}$ -inch No. 14.
- 1 gross each 3-inch No. 14.

B—Round head blued wood screws.

- 1 gross $\frac{3}{4}$ -inch No. 6.
- 1 gross $1\frac{1}{4}$ -inch No. 10.

Bolts:

Machine bolts.

- 1 package each of $50\frac{3}{8}$ by $2\frac{3}{4}$ -inch, $\frac{3}{8}$ by 3-inch, $\frac{3}{8}$ by 4-inch, $50\frac{1}{2}$ by 5-inch, $\frac{1}{2}$ by 6-inch, $\frac{1}{2}$ by $6\frac{1}{2}$ -inch, $\frac{1}{2}$ by $8\frac{1}{2}$ -inch, $\frac{1}{2}$ by 9-inch, $\frac{1}{2}$ by 14-inch.

Carriage bolts.

- 1 package each of $50\frac{3}{8}$ by 2-inch, $\frac{3}{8}$ by $2\frac{1}{4}$ -inch, $\frac{3}{8}$ by 3-inch, $\frac{3}{8}$ by $3\frac{1}{2}$ -inch, $\frac{3}{8}$ by 4-inch, $\frac{3}{8}$ by $4\frac{1}{2}$ -inch, $\frac{3}{8}$ by 5-inch, $\frac{3}{8}$ by $6\frac{1}{2}$ -inch, $\frac{3}{8}$ by 7-inch.
- 1 package each of $100\frac{1}{4}$ by $1\frac{1}{2}$ -inch, $\frac{1}{4}$ by 2-inch, $\frac{1}{4}$ by $2\frac{1}{2}$ -inch, $\frac{1}{4}$ by 3-inch, $\frac{1}{4}$ by $3\frac{1}{2}$ -inch, $\frac{1}{4}$ by 4-inch, $\frac{1}{4}$ by 5-inch, $\frac{1}{4}$ by $5\frac{1}{2}$ -inch.

Thumbnuts, 1 pound.

Washers, 1 pound, $\frac{1}{4}$ -inch.Nuts, 1 pound, $\frac{1}{4}$ -inch.

Hinges:

- 1 box riveted steel butt hinges.
- 1 dozen 6-inch light T hinges.
- 1 dozen screw hook and strap hinges for gates.

Rivets: 1 pound, $\frac{1}{4}$ by $1\frac{3}{4}$ -inch, $\frac{1}{4}$ by $3\frac{1}{2}$ -inch, $\frac{1}{4}$ by $3\frac{3}{4}$ -inch, $\frac{1}{4}$ by $5\frac{1}{4}$ -inch.Poultry Netting Staples: 1 box, 10 pounds, each $\frac{3}{4}$ -inch, $\frac{7}{8}$ -inch, 1-inch.

Quantity 1-inch mesh chicken wire.

Quantity of canvas strap for ladders.

Quantity $\frac{1}{4}$ -inch rod—20-inch for each milk record sheet case.Quantity $\frac{3}{8}$ -inch rod—for fruit ladders and hay rack clamps.*Bill of lumber*

This bill of lumber must be modified to fit the projects actually to be constructed by the students.

200 feet of $\frac{1}{2}$ -inch lumber—cypress, poplar, pine, basswood, soft red pine, sugar pine, white pine, western white pine, spruce, redwood (or cedar) red—width 10 inches and over, length 12 feet and over.

500 feet of lumber, 1-inch, kind same as above, width 10 inches and over, length 12 feet and over.

100 feet of 2 by 6-inch lumber, same as above.
 50 feet of 1-inch red oak.
 50 feet of 2-inch white oak.
 200 feet 2 by 8 by 16-inch hard pine or cypress.
 100 feet 2 by 4 by 16-inch hard pine or cypress.
 100 feet $1\frac{3}{8}$ by 6 by 16-inch hard pine flooring.
 200 feet 2 by 10 by 16-inch yellow pine.

PART II. STUDENTS' INSTRUCTION SHEETS

These Students' Instruction Sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the Students' Instruction Sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS TO STUDENTS

1. Have only necessary tools at your bench.
2. Keep the bench clean of shavings and scrap lumber.
3. Label each piece neatly with pencil and keep them according to some system on the bench when at work.
4. Don't begin the making of a project until you are able to reduce a piece of stock to the dimensions, length, width, and thickness.
5. Have clearly in mind just what you aim to accomplish by each effort.
6. Work carefully and try to attain accuracy. Accuracy at slow rate of work is preferable to the reverse.
7. In using the saws as illustrated in Figures 15 and 16 let the body assume a comfortable position so that you could saw all day without undue strain.
8. When using the plane as in Figure 2 stand with the right hip against the bench and look at the plane from the top and back; not from the side.
9. When learning to square an end or edge, the try square should be used very often as shown in Figure 6. Try to "sense the feel" of the proper position of the tool.
10. Bear in mind that an assembled object such as a folding bench, milk record sheet case, hay rack, or other articles which is made up of several pieces has to have each piece reduced to the dimensions called for in the bill of material or drawing, in order that they can fit together into a finished article with a workmanlike appearance. Hence the importance of learning at the beginning how to reduce a piece of stock to given dimensions accurately.

Lesson 1.—Problem: Construct a folding bench

A. Study drawing and directions on pages 16 and 17 in *Agricultural Woodworking*.

In this lesson the student is expected to learn to reduce stock to required dimensions in length, width, and thickness. Read pages 6 and 7.

Before proceeding with the construction of the bench, study the following:

1. Position of holding tools, illustrations, pages 7 to 19, inclusive.
2. Method of holding hammer, page 21.
3. Light stroke when starting saw, pages 7 and 13.
4. Setting plane, page 11.
5. Use of bit, page 9.
6. Method of cutting chamfer, page 19.
7. Setting nails with nail set, page 21.
8. Proper method of holding the dividers for swinging an arc, figure 7, page 9.
9. Proper method of holding a chisel for rounding ends of legs, figure 8, page 9.
10. Proper position of holding screw driver in hand, figure 14, page 13.
11. Proper method of guiding a saw in starting a saw cut, figure 15, page 13.
12. Laying out a half-lap joint.

B. Construct the folding bench according to directions on pages 16 and 17.

C. Questions:

1. What is the essential difference between the rip saw and crosscut saw? See Why a Saw Cuts, pages 5 and 6.
2. Why hold the plane at a slant as shown in figure 2?
3. What is the advantage of using a bench hook? See page 7.
4. In figure 10, why feel for the point of the bit?
5. How are sizes of bits designated?
6. What is the advantage of the ratchet in a brace?
7. How are sizes of saws designated? See Atkins's Silver Steel Saws.
8. How is a plane bit or chisel sharpened? See Agricultural Woodworking, page 24.
9. What are the uses that the bench may be put to on a farm?
10. What are the advantages of the folding feature of the bench?
11. How and where would you hang it when not in use?
12. What dimensions would you change if you wished to use the bench for unusually heavy purposes?
13. Why is cypress a good wood to use for this purpose? See "Bald cypress" in Kellog, Lumber and Its Uses, page 253.
14. Why are flat-head screws preferable to round heads in constructing the bench?
15. What is the objection to the use of nails in assembling the bench?
16. What would be the objection to throwing the legs still farther from a vertical position?
17. Give instances where the bench on page 42 would be better than the one on page 16.
18. Refer to Kellog, Lumber and Its Uses, and list the various kinds of lumber suitable for benches.
19. Where, in the various pieces of which the bench is made, would a knot be the least objectionable?
20. Where, in a platform member of the bench, would a knot be most objectionable, near the upper or near the lower edge?
21. Of the lumber available in your locality, which is most free from knots?
22. In constructing the barn on pages 122-125, where is clear lumber essential and where may knotty lumber be used without marring strength of the structure? See Kellog, page 65, concerning knots.

Lesson 2.—Problem: Construct a daily milk record sheet case

A. Study drawings and directions on pages 72, 73, and 74 of Agricultural Woodworking. Special points to study before proceeding with the construction:

1. Method of locking the cylinder onto the rod.
 2. Method of locking the cylinder in position at any place in the box.
 3. How to lay out and cut the bevel on bottom side of the two top pieces.
 4. Direction 7, how to bend an edge of a sheet of tin.
 5. How to bend tin to a cylindrical form without kinking it.
- B. Construct the daily milk record sheet case according to directions given on pages 72 and 73.
- C. Questions:
1. What are the reasons for keeping a milk record?
 2. What advantage is it to make a record on a sheet which is inclosed as this one over the wall method?
 3. What method of keeping records is employed in creameries and cheese factories?
 4. How does the tinsmith bend tin into cylindrical form?
 5. Which is the better tool for removing kinks from sheet metal, the wooden mallet or the metal hammer?
 6. Where would you suggest keeping the record case?
 7. If you set it on the brackets, which would be preferable, to build the brackets so as to hold the top of the box level or at a slant?
 8. How would you construct the brackets?
 9. How would you measure off and line record sheets as shown on page 74?

Lesson 3.—Problem: Construct a flat hayrack

A. Study drawing and directions, pages 82 and 83 of *Agricultural Woodworking*.
Special points for study before proceeding with construction:

1. Yellow pine, Kellog.
2. Mortise and tenon joint, used in standards.
3. Methods of fastening standards, study detail drawing.
4. Direction 5, reason for building platform in sections.
5. How to lay out and cut slant on arms.
- B. Construct the hayrack according to directions given on page 83.

C. Questions:

1. How wide should the hayrack be to be used in the driveway of the barn shown in plan on page 123 of *Agricultural Woodworking*? For the one shown on page 126?
2. What is the maximum width of hayrack that should be used under ordinary conditions?
3. When would you use a basket rack? When a flat rack?
4. Find specimens of each kind of nails; common, casing, finishing.
5. How are nails usually specified or mentioned as to length? As to size (diameter)?
6. How many nails of each size are there in a pound? How can this be determined without referring to a table of sizes and weights?
7. How many nails would you order to use in 1,000 feet of sheathing? Of clapboards, etc.? (Problems in Carpentry, p. 107.)
8. What sizes of nails are ordinarily used for given purposes in carpentry? (Problems in Carpentry, p. 108.)
9. Make out a bill for the nails needed for implement shed shown on page 120 of *Agricultural Woodworking*.
10. Which rack is easier to store when not in use, the one on page 82 or the one on page 98, and why?
11. What is the advantage of having the front standard drop down onto the rack, as is the case with the one on page 98?
12. In fastening the floor boards which is the better method, screws or nails, and which is the more expensive?
13. What is the reason for painting a hayrack? How many coats of paint should be used and how much time is required to dry?
14. What other wood may be used for hayracks? (See Kellog, *Lumber and Its Uses*.)
15. Why have a tight floor in a hay rack?
16. How would you store the rack in the implement shed shown on page 120?
17. What advantage is there in driving into a barn with a load of hay onto driveways, as shown in the barn on page 125 over unloading hay into a barn from the end?

Lesson 4.—Study of the silo form

(Pages 111-112, *Agricultural Woodworking*. May be undertaken as a group problem if circumstances make it advisable)

1. What woods would be suitable for ribs, splices, and braces?
2. How would you swing an arc with a 6-foot radius for laying out the ribs?
3. Which do you prefer in a silo, a continuous door or a series of doors?
4. Why is matched lumber preferable for the outside of the inside form?
5. What kind of nails are used for nailing the flooring?
6. Note the holes in the ribs for 2 by 4 inch posts on which to elevate the forms when in use.
7. What would you suggest for keys through the 2 by 4 inch pieces under the lower rit to hold the form up?
8. See figure 41 and note the method of holding the outside and inside forms exactly 6 inches apart.
9. In figure 41 note the lugs and bolts on the extreme left for drawing the outside form up tight.
10. Also note that the splices at the joints are numbered, so that when the form is reassembled for different silos each splice will be placed in the original position.

11. Notice in the door construction that the pieces of 2 by 6 inches which are the uprights and are in the position of the door frame are hinged to the outside of one inside form. The hinges permit these pieces of 2 by 6 inches to swing inward when the concrete is dry and the form elevated, and slide past the rods which have been placed across the door opening for tying the silo across the opening, and act as rungs of the ladder. The 2 by 6 inch pieces are held apart by the 2 by 2 inch brace which is forced between them. The 2 by 2 inch pieces which are at the outside of the 2 by 6 inch pieces form a recess in the concrete wall where 2-inch planks or a 2-inch door fit into as the silo is filled.

Lesson 5.—Questions on the dairy barn

(Pages 122-125, Agricultural Woodworking)

1. Why is 36 feet the best width for a dairy barn?
2. What is the width of a cow stall?
3. What is the best length for the average cow stall?
4. What is the maximum and minimum length of stall?
5. What are the most satisfactory dimensions of a gutter?
6. How much incline should be given a cow stall?
7. Why should the space between gutters be crowned and how much crown should there be?
8. In building, how may the crown be obtained?
9. What should be the distance between gutters in a barn in which the cattle face out?
10. What should be the width of a cow manger?
11. How much space should be provided for the feeding alley in front of the manger?
12. What shape or shapes of manger have been found by experience the most satisfactory?
13. What thickness of concrete wall is usually used?
14. What are the advantages of the arrangement of a barn where the cattle face out, and what advantages has the arrangement where the cattle face in?
15. What should be the position of the litter carrier in relation to the gutter?
16. What provision should be made in the barn for box stalls and calf pens?
17. Should the main gutter extend through the calf pens and box stalls?
18. Tell of a satisfactory way of draining the pens.
19. What direction should the doors of pens swing?
20. What is a satisfactory size of a box stall?
21. What is a satisfactory width of manger for a calf pen?
22. What feeding arrangement would you suggest for a box stall?
23. What should be the width of door of a box stall?
24. What width and height of door do you recommend for the feed room?
25. What size of timber is used for main floor beam?
26. What should be the size of post for supporting the main floor beam if wooden post is used?
27. If the barn is arranged for driving through, what should be the width of the end door?
28. What should be the height of ceiling of dairy barn?
29. How do you figure the amount of window pane to be used in a dairy barn?
30. What is a satisfactory size and shape of window?
31. How should the windows be hung?
32. How far from the floor should the windows be placed?
33. How would you place the doors in the partition between the horse and cow barn?
34. What should be the dimensions of these doors?
35. Should the partition doors be rolling or swinging, and which way should they roll or swing?
36. Why should the milk house be a separate building?
37. Why should the engine room be separate from the milk room?
38. What method is satisfactory for transmitting the power from engine to milk room?
39. What dimensions would you recommend for the milk room and engine room?

40. What arrangement can be made so that the milk house and engine room are in a separate building, yet so arranged that one may go from the barn to milk house without going outside?

41. Where would you place the milk house in relation to the rest of the barn?

42. How should the fresh-air intakes be placed in the wall, and what should be their size and how many?

43. What should be the size of the foul-air flues, and what should be their location and how many?

44. How should the foul-air flues be constructed?

45. How near to the floor shall the intake of the foul-air flues be placed?

46. How near to the ceiling shall the outlet of the fresh-air intake be placed?

47. What may be the construction of the fresh-air intake?

48. How may a driveway and approach be arranged so as not to exclude light from the barn?

49. What use may be made of the space under the bridge?

50. If the space under the bridge is used for a bull pen, what door and window arrangement is advisable?

51. Where would you place the stairway in a barn?

52. How do you obtain the run and rise of a stair?

53. Explain how to lay out a stair.

54. What width of stair should be used in a barn?

55. What may be the width of driveway on the second floor?

56. What should be the floor construction of the driveway?

57. What size of timbers should be used for joists and how close on center?

58. What is a good method of sill construction?

59. What flooring should be used in the mow and granary?

60. Explain the method of laying the sill and fastening it to the wall.

61. Where is the header placed and how fastened?

62. How much bridging should there be, what size and how fastened?

63. Explain a satisfactory granary arrangement on the second floor.

64. How would you build partitions between grain bins?

65. How would you construct openings into the bins from the alley?

66. Explain the construction of a hopper.

68. Where should the hay chutes be placed and how built?

69. How high should the roof plate be from the wall plate?

70. What shall be the construction of the roof plate?

71. What shall be the construction of the corner post?

72. What size of timbers are used for posts or studs, where are they placed and how braced?

73. What size of timber is used for girts and how are they placed?

74. What are the advantages of a gambrel roof?

75. What size of timber shall be used for the main brace in the truss?

76. What size of timbers are used for the purline plate? Explain the construction.

77. What size of timber is used for the main strut? How is it fastened to the post below the roof plate?

78. What size of timbers are used for the upper and lower rafters?

79. How do you lay out the upper and lower rafters on a gambrel roof?

80. What size of timber is used for the false rafters and at what pitch is it cut?

81. Explain the construction of the lookout at the end of the barn.

82. How should the roof boards be laid?

83. How much should shingles be laid to the weather?

84. Explain the construction and hanging of the driveway doors.

85. How do you lay out the plate for the silo?

Rehabilitation monograph. Joint Series No. 30.

Unit Course—Shoe Repairing I—Handwork Necessary to Prepare Shoes for Machine Finishing

HANDWORK NECESSARY TO PREPARE SHOES FOR MACHINE FINISHING

February, 1919—Trial edition

PART I. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This unit is designed for those who have never had any experience in shoe repairing or those who have had shoemaking experience but not in the shoe-repairing line, such as machine operator in shoe factory.

2. ADVANTAGES TO THE STUDENT

This unit course will give a foundation which will prepare the student to hold a position as "benchman" in shoe-repair shops.

There is a great demand for help of this kind at present and at good wages.

The subsequent unit to consist of machine work will prepare student to become a proprietor of a shoe-repair shop which can be established with a very small outlay of capital. It will also fit him to become manager or head operator of a shoe-repair shop at an excellent salary.

3. TIME REQUIRED

This unit should be completed in approximately 30 hours, divided into 15 lessons of study and practice. Speed should not be attempted in these lessons; accuracy and neatness should be insisted upon.

After completing these lessons and tasks, means should be provided for the pupil to continue the practice so that the foundation laid here may not be lost.

This is extremely important, as it is useless to suppose that great skill can be acquired in the time allowed for these lessons.

4. EQUIPMENT NECESSARY

The following unit of equipment should be obtained for each student:

1 pound 8/8-13 shoe nails.	1 No. 3 sewing-awl haft.
1 pound 6/8-13 shoe nails.	2 No. 4 sewing awls.
½ pound 4/8 curl nails.	2 No. 8 sewing awls.
½ pound 4½/8 curl nails.	1 pegging-awl haft, No. 2, Star brand.
1 pound 5½/8 curl nails.	2 No. 2 pegging awls.
1 pound 6/8 curl nails.	2 No. 4 pegging awls.
1 ball brown hand wax.	1 spool 500-20-4 white soft finish thread.
1 ball Barbour's No. 10 hand thread.	½ pint Climax cement.
1 rasp, 6 inch.	½ ounce bottle Union leather cement.
1 Bernard nipper, 6 inch.	¼ sheet of tarred felt.
1 heel remover.	1 yard of welt, grooved and beveled ½ by ⅛.
1 heel pincer, 8 inch.	½ pound heeling.
2 No. 1 square-point knives.	12 pair top lifts.
1 No. 3 square-point knife.	12 pair half soles } or 9 blocks.
1 McKay sewing knife.	3 pair whole soles }
1 knife sharpener.	⅛ pound patching leather (upper).
1 lap stand with lasts.	1 upper stitching machine for each 5 pupils
1 cobbler's hammer, No. 3, knurled face.	in the class.
1 No. 3 OED heel shave.	1 dozen needles for same.
1 No. 0 oil stone.	1 dozen No. 0 shoe stretchers.
1 nail set.	1 sit-down bench.
1 package (12) bristles.	

This equipment can be purchased from reliable dealers and could be assembled and packed in a separate box with hinges, for each student, or it may be purchased in bulk, simply providing the above unit for each pupil.

There should also be secured a supply of shoes to be repaired. These may sometimes be obtained from the quartermaster's department of the military post, from near-by charitable institutions, or from the public through advertising.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Course of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shopwork are available, it is recommended that final rating be recorded as follows: The average student will be rated "good," the student of exceptional ability will be rated "excellent," while the student of lesser ability will be rated "fair." The student producing work of a quality that would be rejected in the commercial shop should be rated "poor."

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

1. *Execution of work.*—(a) Time: Is the student rapid, moderate, or slow in executing his work? (b) Technique: Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

2. *Finished product.*—(a) Accuracy: Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc. (b) Quality: Consider the finished product in other respects than accuracy, such as finish, neatness, etc. (c) Mastery of principles: Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

3. *Interest.*—(a) Attitude toward work: Does the student love his work or does he watch the clock? Is he likely to continue in this line of work? (b) Studiousness: Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects? (c) Possibilities of growth: Is the student likely in due time to receive promotion to positions of greater responsibility?

4. *Test problem.*—A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

Outline of lessons

Lesson No 1.—Show detail construction of shoes of different types—Goodyear welt, McKay, and nailed.

Explanation of articles and tools furnished in each unit equipment.

Lesson No. 2.—Repairing worn heels.

Lesson No. 3.—Practical work on heels.

Lesson No. 4.—Preparing welt shoes for half soles to be sewed and finished on machine.

Lesson No. 5.—Sewing in new welt and preparing waxed ends.

Lessons Nos. 6 and 7.—Practical work on subjects contained in lesson Nos. 4 and 5.

Lesson No. 8.—Preparing welt shoes for whole soles to be sewed and finished on machines.

Lesson No. 9.—Practical work on lesson No. 8.

Lesson No. 10.—Preparing McKay or welt shoes for half soles to be nailed on by hand and finished on machine.

Lesson No. 11.—Practical work on lesson No. 10.

Lesson No. 12.—Preparing ribs in the uppers, putting in new backstays and counter-lining, etc.

Lesson No. 13.—Practical work on lesson No. 12.

Lessons Nos. 14 and 15.—Should be devoted to practical work and student should be given the tasks that appear most difficult for him to perform.

Suggestions to instructors

Lesson No. 1.—The instructor should have at hand shoes of Goodyear welt, McKay sewed, and nailed constructions.

These should be ripped up before the class and the different component parts explained thoroughly, such as upper, counter, box toe, welt seams, McKay seam, outer seam, fair stitching, etc.; also method of construction of each type should be explained.

Explain the use of each tool in the equipment, giving also points on tempering leather and the use of cement, both sole sticking and upper leather. It would also be well for pupils to rip up shoes, as by so doing they will be better able to comprehend the method of construction.

Lesson No. 2.—This lesson should be confined wholly to ripping off of worn portion of heels and rebuilding them.

First explain the method of rebuilding by wedges, having the pupils do the work.

Next explain the method of cutting off the portion of the lift that is worn and filling it out with new stock. See that no more of the old heel is removed than is necessary to do the work properly.

Insist on perfect spacing of nails, and impress upon the pupils the importance of each heel being the same height, and have top lift level, not bunched up in the middle or higher on one side than the other.

Use peg awl to insure perfect driving of nails.

Lesson No. 3.—Should be a lesson continuing the practical work of lesson No. 2.

Lesson No. 4.—This lesson should embrace the ripping off of the old sole and fitting on a new half sole.

The importance of smooth, even scarfing of the old shank portion should be pointed out.

The matter of tempering stock having been taken up in the first lesson, it should now be put in practice.

The half sole should be skived at the butt and the half sole and welt cemented and then nailed across the butt.

Impress upon the pupil that care should be taken in selecting the length of nail used in this operation and insist on careful spacing of nails.

Have the new half sole trimmed up to the old welt. This work should be carried out on shoes, the heels of which have been prepared in the early lessons.

Lesson No. 5.—For this lesson the instructor should pick out shoes with weak or broken welts and after ripping off the old sole the instructor should point out to the pupil why the welt must be reinforced, or a new piece sewed on.

The pupil should be instructed in making waxed ends and in attaching bristles to same, and this lesson will call for personal instruction in this work.

Lessons Nos. 6 and 7.—Devoted to a continuation along practical working lines as laid down for lessons Nos. 5 and 6.

Lesson No. 8.—This lesson embraces the preparing of the welt shoe for a whole sole.

The system most commonly used is splicing the new sole just back of the breast of the heel. This does not disturb the original heel seat. The whole heel should first be removed; the splicing cut should not be at too great an angle, and a neat joint must be insisted on. If properly done this joint is almost invisible when the job is completed.

Cement should be used to attach the new sole; be sure that the heel when put back is straight. This should not be done, however, until after the new sole is sewed on.

Lesson No. 9.—Devoted to doing the work outlined in lesson No. 8.

Lesson No. 10.—This lesson should proceed as on the welt shoe. If McKay or nailed shoes are not at hand, the work can be done on a Goodyear-welt shoe by carefully selecting shoes on which a tap or half sole can be nailed on over the old sole.

Insist on careful spacing of nails, and have pupils use a peg awl to start nails to insure proper clinch.

Instruct pupil on selecting the proper length nail and guard against using nails too long.

Have them inspect shoes on the inside to be sure each nail is clinched.

Explain that too many nails make a shoe stiff and have them use just enough nails to hold the half sole tightly around the edges.

Lesson No. 11.—Continuing practical work contained in lesson No. 8.

Lesson No. 12.—The instructor should have all the shoes used in previous lessons, and which require upper patching or rips to be sewed up, saved for this lesson.

This lesson will call for a lot of personal instruction, as each job will require instruction peculiar to itself.

The use of the patching machine should be explained and how to thread and oil same.

Many shoe repairers are known through their ability to do a neat patching job, and this work requires practice. Insist on neatness and small stitches, and in the case of sewing rips try to have the new stitches follow the old needle holes.

Lesson No. 13.—Practical work on lesson No. 12 and assort the work so that each pupil will get a variety of jobs.

This work can be carried on by having one patching machine for each five pupils. While some are inserting and preparing patches, one at a time can use the machine.

While explaining the use of the machine, the whole class can be assembled around it and general instructions given which will be of benefit to all.

Lessons Nos. 14 and 15.—These lessons should be working lessons, and the work assigned to each pupil should embrace the work which has previously been covered and which, in the instructor's mind, the pupil needs further training on.

PART II. STUDENTS' INSTRUCTION SHEETS

These Students' Instruction Sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the Students' Instruction Sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

Students taking this course should realize that the instructions contained here are laid out as a guide, that all work may be done in a uniform manner.

The lessons will give a general idea as to how the different tasks should be performed, and the student will be better prepared to do the tasks outlined if he will follow directions as given in each lesson.

Practice, however, is the essential thing and the student will advance fastest who arranges to put in the greatest amount of time to the actual work of performing the tasks given.

Have in mind that in the time allowed for these lessons you have had the work only outlined, and that much time must be given over to practice before the tasks can be performed in a thoroughly satisfactory way.

LESSON NO. 1

The instructor will provide each pupil with shoes of different construction to rip up so as to learn the way different shoes are made.

Take the Goodyear-welt shoe and study the chart below, which outlines clearly the different parts of this type of shoe.

Notice that the insole is smooth with no nails or tacks except at the heel seat.

Pay particular attention to the way the upper, lining, welt, and insole are brought together. This is called the inseam.

When ripping up a shoe to be repaired, this seam should always be looked over to see that no threads are broken and that the welt is in good condition.

The Goodyear-welt shoe is the type most commonly worn, and you will have more work to do on this type shoe than on any other, so let us now rip one up and see how it is made.

Take your sharp-pointed knife and insert it between the outsole and welt and, cutting away from you, cut the stitches which hold the outsole and welt together from ball to ball, lay back the old sole and cut it off straight across, exposing the cork filling. Next remove the cork filling and expose the channel which holds the insole.

Notice how this seam holds the upper welt and insole together. You can now see why it is necessary to use a filler in the forepart of this type of shoe.

If the outsole were put on without filling up the space between the insole and the welt seam, the shoe would not have a flat bottom or keep in shape.

Notice how the shank piece is put in place; this is used to give shape and strength to the shank of the shoe.

In order to properly repair a welt shoe the new sole or half sole should be sewed on in the same way as the original sole was sewed on.

In the McKay and nailed type of shoes the upper, lining, and insole are fastened together with lasting tacks which go through the insole and clinch.

In the McKay shoe the outsole is sewed to the insole by a stitch that goes through both outsole and insole.

In the nailed shoe the outsole is fastened on by nails, machine driven, which go through both outsole and insole and clinch.

Neither of these types of shoes is as smooth inside as the Goodyear-welt shoe.

Rip up shoes of these types and notice the different construction, and also see the difference between these types and the Goodyear-welt shoe.

Now, take the outfit of tools and equipment and let us determine the use of the more important tools.

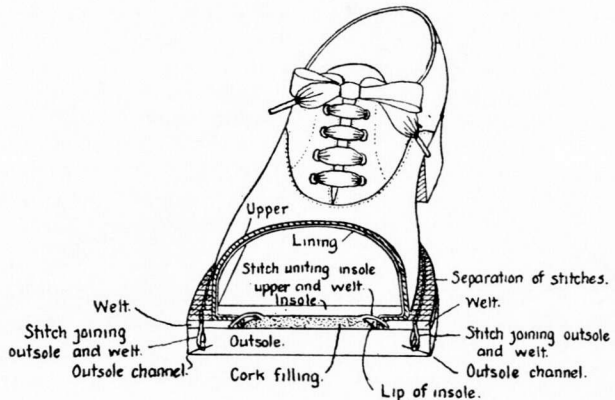


FIG. 1

Shoe nails.—Used in repairing heels.

Curl nails.—Used in nailing on soles or the butts of taps.

Brown hand wax.—Used to wax hand threads in making waxed ends.

No. 12 hand thread.—This is the unit which is used in making waxed threads. The waxed end is made up of as many strands as is needed of the No. 10 thread twisted together and waxed.

Bernard nipper, 6-inch.—Used in cutting old nails.

Six-inch rasp.—Used for evening up uneven places in old leather before putting on new.

Heel remover.—For starting and removing old top lifts and worn lifts on heels.

Heel pincer, 8-inch.—Used to assist in ripping off old heels, top lifts, etc.

No. 1 square-point knife.—For trimming up and cutting new leather.

No. 3 square-point knife.—For skiving use.

McKay sewing knife.—For cutting stitches in ripping off old soles.

Knife sharpener.—For sharpening knives.

Lap last and stand.—This style last and stand was selected for this course because of the small space taken up and the ease with which it can be moved from place to place. Used in nailing and heeling to give solid foundation and for clinching nails.

Heel shave.—Used in trimming up smooth the new lifts used in repairing heels.

No. 0 oil stone.—Flat sides for knife sharpening; the oval side for sharpening blades for the heel shave.

Bristles.—Used in making waxed ends.

Sewing awl and haft.—Used in hand sewing to make the hole in the leather through which the waxed threads are passed.

Peg awl and haft.—Used to make holes for nailing so that the nail will be sure to go in the direction desired. Without the use of these tools the novice will have much difficulty in driving nails straight.

20-4 white thread.—Used in patching machine for sewing rips and patches.

Climax cement.—Used to make sole or half sole stay in place. This cement should be applied to each surface to be stuck together and should be allowed to dry before the parts are placed together. The cement should be applied to the flesh side of the leather which should be clean and dry. After cement has been applied and dried the leather may be wet if necessary.

Union leather cement.—Used in patching with upper leather. The surfaces to be stuck together should be dry and clean and roughed up with rasp or sandpaper. After applying cement and letting it dry the two surfaces should be placed together and a little heat applied, which will cause the two pieces to stick together.

Tarred felt.—Used in between half sole and insole in repairing shoes. Prevents squeaking and fills up space, so that a full round bottom with no hollows may be obtained.

Welting.—Used when necessary to repair broken or weak welts.

Heeling.—Used as underlifting in repairing worn heels.

Top lifts.—These should be wet before being used; if quick job is required, just dip in water for a few minutes and use. A better way is to allow them to "temper." This is done by wetting them thoroughly, allowing them to soak for an hour or more, then laying them away in a tight box or wrapped in moist burlap to mull. Stock to be so used should be wet in the afternoon and left to mull overnight and used the next day.

Half soles, whole soles, or blocks.—Should be tempered as outlined. If cement is to be used, they should be cemented on the flesh side and the cement thoroughly dried before the stock is wet. Then proceed as above. Stock will work easier when "in temper" and better results attained.

Questions

What is the inseam on a Goodyear-welt shoe?

What parts of the shoe does it unite?

Describe difference between a Goodyear-welt shoe and a McKay shoe.

Why is cork filler used in the forepart of a Goodyear-welt shoe?

What is the difference between a McKay sewed shoe and a nailed shoe?

What is the use of sewing awl and haft?

What are bristles used for and describe a waxed end?

What is the 8-inch pincer used for?

Describe how Climax or sole-sticking cement should be used.

Describe how Union leather cement is used.

LESSON NO. 2.—REPAIRING WORN HEELS

First place the shoe upon the last and with the heel remover start working off the old top lift. After it is started so you can do so use the 8-inch pincers to pull it off.

Care should be taken to remove only as much of the old heel as is necessary, as of course all old leather removed must be replaced with new, which adds greatly to the cost of doing the job.

After the top lift is removed you will see that probably the lift under it is worn at the back portion of the heel. This should be built up level and can be done in two ways. First by wedges. Take a piece of underlifting which is provided and cut it to shape of the portion of the heel to be built up, then skive the portion down wedge-shape so that the outer edge will be of the right thickness to bring the worn portion of the heel up level. Now, nail the wedge in place, putting the nails well in toward the center of the heel so that they will be out of the way of the top lift nails. Use the hammer to settle the wedge into place and have it level so that the top lift will set even.

Now put the top lift on and drive two 6/8-13 shoe nails, one at the breast and one at the back about $\frac{1}{2}$ inch in from the edge of the heel.

Take the square-point knife and trim up any portion of the new lift that extends beyond the old heel. Hold your knife square to the edge so that you will not cut under and spoil the new top lift by cutting it too small. This work can best be done by taking the shoe off the last and holding it in a convenient position in your hands, using your breast or knee as a rest for the shoe.

You are now ready to nail on the new top lift. First until you become expert it is well to mark a line for nailing to insure an even spacing.

Take the peg awl, and holding it in the right hand between thumb and first finger, using the second finger as a guide against the old heel, scratch a line on the top lift about $\frac{1}{4}$ inch from the edge. This should leave the nails about $\frac{3}{8}$ of an inch from the edge after the heel is finished.

Use the peg awl to make the holes for starting the nails and start them slanting in slightly toward the middle of the heel. Space nails about $\frac{1}{2}$ inch apart except at the back of the heel where the greatest wear comes when they should be only $\frac{1}{8}$ inch apart.

After the top lift has been nailed on use the heel shave to smooth up the new leather which you have just put on so that it will conform to the shape and style of the old heel.

After completing one heel and in going on to the next one be sure to measure the second heel by the first to be sure that they are the same height. This can be done by holding the two shoes soles up, bringing two heel-seat lines together even.

Another way to repair a worn heel is to use a portion of a whole lift instead of a wedge. Proceed as outlined, but instead of putting in the wedge take your knife and cut on a straight line, taking any angle necessary to remove the worn portion of the old lift. Then take your heel remover and take off the portion of the lift so cut out.

Now take a piece of heeling and, cutting one edge square, fit it up against the edge of the portion of the old lift remaining and nail in place.

Any portion of old heel nails left projecting out of the heel when removing old lifts should be cut off with the Bernard cutting nipper. Never drive them in.

LESSON NO. 3

This should be a practice lesson continuing the work outlined in lesson No. 2.

LESSON NO. 4

Take a pair of shoes, the heels of which have been repaired in the previous lessons. Place one upon the last on your knees and rip off the old sole. Insert the sharp-pointed ripping knife between the sole and the welt, just below the ball, and carefully cut the stitches. Care must be used not to cut the welt while doing this operation.

Always cut away from you. After cutting up one side to the toe, turn shoe and last in opposite direction, so that the knife is always going away from you.

After stitches are cut, turn back the forepart of the sole and cut it off straight across at the ball line. Next step is to scarf the old shank piece. This joint should begin about 1 inch below the ball line and parallel to it. The best way to determine the angle of the scarf line is to lay the new stock on the shoe, so that it will cover at the toe and on the sides, then with your awl or back of the knife make a mark across the old shank portion. This line should be the beginning of your scarf, which should be so cut that at the outer edges it is about $\frac{1}{2}$ inch long, running up to 1 inch in the center.

The scarf should be cut even and should be smooth, so that the new tap will lay flat. Care should be taken in scarfing near the edges to see that it is thin, so that there will be no big bunch there when the shoe is finished.

The cut above will give you an idea of the ball line, scarf line, and shape of finished scarf.

Now cut your tarred-felt filler and place in position, taking care that it does not overlap the in seam, and cement the welt, scarf, and filler, and set shoe aside for cement to dry, and repeat operation on the next shoe.

By the time your second shoe is done the first will be ready to have the new half sole attached. The half soles having been selected in advance, the butt skived evenly about $\frac{3}{4}$ -inch scarf, and having been cemented and tempered, we are now ready to attach same to the shoe.

Hold the new half sole in the right hand with the grain side next to the palm and grasped by the edges with the fingers, now hold the half sole at an angle which will allow just the scarf of the butt of the tap to be placed in position evenly on the scarf prepared on the shoe, then lay flat on the shoe. Take your hammer and hammer around the edges of the tap and across the butt which will make the cement hold tight. Now nail across the butt of the tap, selecting length of nail that will just go through to the insole and clinch, and keeping the nails at the extreme edges just inside of the line of the outer seam.

Nails should be about one-fourth inch apart and three-sixteenths of an inch from the edge of the butt of the half sole.

The shoe is now ready to trim up. This is done by taking it off the last and holding it sole down in the left hand. Trim off surplus stock up to the welt, keeping the knife straight with the edge so you will get a square cut. In this operation it is necessary to cut

toward you. The neatness with which the job can be finished depends upon the neatness with which the new half sole is trimmed up. Be careful not to cut under and be sure that the shape and size of the half sole when trimmed is exactly the same as the welt to which it is being fitted.

Repeat the above on second shoe, and do not make any attempt at speed; neatness of work is what counts.

After you can do the job right speed will come to you with practice.

LESSON NO. 5

This lesson embraces the main points as laid down in the previous lesson, except that shoes will be selected which need a new

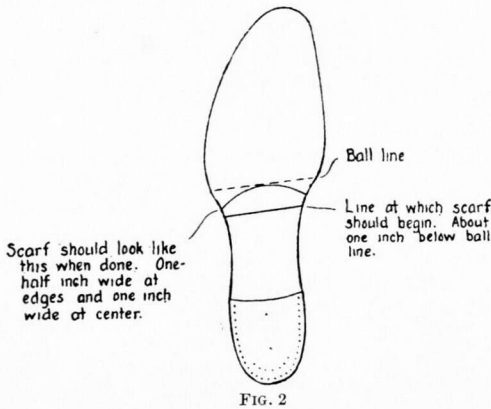


FIG. 2

piece of welt sewed in or a few stitches taken to reinforce the insole.

Rip off the old sole and scarf, shank, and half-sole as in the previous lesson.

The instructor will give personal instruction as to the making of a waxed thread and the method of attaching the bristle.

To sew in a piece of new welt the portion of the old broken welt must be cut out and the new piece of welt cut to fit; the new piece should lap over the old at starting and under at the finish. Welt should be sewed in in one direction always.

To determine this, the shoe being held sole up, the starting side is at the left side and follows around to the right side. Therefore, if you are to sew in a piece of welt on the left side of the shoe, you should sew from heel to toe, and if on the right side, from toe to heel; in other words, always sew from left to right, the left end being lapped over the old welt and the right under.

To start the new piece, first skive the grain side on the end for about one-half inch, then cut back one stitch on the old welt so that the old welt will be loose for about one-half inch, and skive the flesh side for about one-half inch. Now lap the grain side of the new welt to the flesh side of the old welt, putting your first stitch through both pieces.

In finishing, reverse the operation, skiving the flesh side of the new welt and grain side of the old and put the new welt under the old and let your last stitch fasten both.

Now take your hammer and pound down the seam and lay the welt out flat and trim it up to conform to the shape of the shoe. Care should be taken to have the hand stitches even and try to have them follow in the old holes as nearly as possible.

Draw your hand threads tight and be sure that the channel of the insole is turned up well, so that stitches may be easily inserted and that the new stitches take in all the upper lining and between substance on the insole.

LESSONS NOS. 6 AND 7

Devote all the time in these lessons to practice, doing the tasks as laid out in lessons Nos. 4 and 5.

Any point in the previous lessons not clear to the student should be taken up with the instructor, who will show you any point not thoroughly understood.

LESSON NO. 8

The first move in this lesson is to remove the worn part of the heel, as in lesson No. 2, then take off the whole heel. Start it at the breast with the heel remover working it around under the edges as the heel starts to come off, but be careful not to damage it, as it will be used again after the new sole is in place.

Now cut the stitches between the welt and the old sole all the way around from heel to heel.

Next pull the sole off clear back to the heel nails and pull out the first two or three heel-seat nails that come next to where the breast of the heel was.

When this is done the old sole is loose back about three-fourths of an inch from the old heel-breast line. This can be plainly seen, as the old heel line will be plainly visible on the old sole.

Next take your knife and cut off the old sole on a line parallel with the heel-breast line and be sure to hold your knife so as to get a good square cut.

Now take the new sole and cut the edge where it is to join against the old heel piece, so that when it is placed in position it will fit tightly against the old edge so that you will have a close joint.

Next put the tarred felt filling in the forepart and cement the whole bottom and lay aside to dry.

Do the next shoe in the same manner and the first one will be ready to lay the sole on.

The whole sole should be laid the same as a half sole, attaching the heel seat portion first, making sure that it fits snug where the joint comes. Now lay sole down on the shoe and use the hammer to make it lay tight around the edges.

Next nail across the butt where the splice comes, slanting your nails in the new piece lightly so as to draw it tight against the old piece. Nails should be about one-quarter inch from the edge and about one-quarter inch apart.

The old piece should now have a few nails driven into it, slanting the nails to draw it toward the new piece.

You are now ready to trim off the surplus stock, taking the shoe off the last and holding in the left hand and in any convenient position for cutting.

Follow directions for trimming up as in lesson No. 4, and the same general instructions given in that lesson will apply here. Make your cuts clean and don't leave the edges full of notches.

After the sole has been stitched on, the shoe will be returned to you to have the heel attached. Take the old heel and place it squarely in position, taking care to get it back in position exactly as it was originally, and, using a nail just long enough to go through into the insole, nail it in place; driving your nails in far enough from the edge so that nails used in putting on the new top lift will not interfere with these.

A good guide to go by will be the nail holes in the old heel.

Now repair the heel as outlined in lesson No. 2 and the task is complete.

LESSON NO. 9

Devote your whole time in this lesson to repeating the work outlined in lesson No. 8. Remember that "practice makes perfect," and one job correctly done is better than two half done.

LESSON NO. 10

This lesson is on nailing on of half soles, either on Goodyear welt or McKay shoes.

If the work is done on McKay shoes no part of the old sole should be removed, the new half sole being nailed on over the old sole.

If the old sole is worn uneven in places the bottom should be made level before placing the new half sole in position.

Take your 6-inch rasp and buff down the thick parts and cut wedges to fit in the thin parts so that the thickness of the edges will be the same all the way around. Trim up any wedges used to the shape of the shoe.

There is no cement used in this work and no scarfing necessary on the old shoe.

Take your half sole, and after seeing that it is in temper, scarf the butt, and after placing a piece of tarred felt on the forepart of the shoe, lay on the new half sole, placing it the same as in the Goodyear-welt shoe about 1 inch below the ball line and the edge of the half sole parallel to it.

Now nail across the butt of the half sole and drawing it even place one nail in the center of the toe about $1\frac{1}{2}$ inches from the edge.

Next take the shoe from the last and trim off the surplus leather. The half sole on nailed work should not be trimmed up quite as close to the old shoe as for sewed work. It should be even and should project about one sixteenth of an inch evenly all the way around. This is to allow for the drawing in of the leather when the shoe is nailed.

You are now ready to proceed with the nailing. To insure good lines make a line where the nails should go with the peg awl the same as in repairing heels.

Place nails so that they will clinch just inside of the edge of the insole. Keep the nails so close to the edge of the new half sole as will permit of this being done. The reason for this is that if the nails are too far in toward the center, the edge of the shoe will not be tight.

Use peg awl to start your nails and start them toward the center of the shoe.

Be sure to use the proper length nail, one that will just go through the insole and allow the point about one-sixteenth of an inch for clinch.

A nail too long will not clinch but will turn, and it is impossible to hammer these down so that they will not hurt the wearer.

Do not use too many nails as they will make the shoe too stiff. Space about one-half inch apart is usually sufficient to make a tight job.

Use force enough on the hammer to draw the new sole down tight, and after nailing is completed pound down any uneven places.

After nailing always take your shoe off the last and feel inside to be sure that all nails are properly clinched.

Now trim up the edges again, if there are any uneven places in them.

If the work is done on Goodyear-welt shoes, select shoes on which the welt is good.

Even up the soles as in McKay-sewed shoes and proceed as before. In nailing, however, the width of the welt will have to be considered. Use more slant on the nails, and if your nail clinches just inside the edge of the insole you will get a good tight job.

LESSON NO. 11

Continue the practice on work as outlined in lesson No. 10.

LESSON NO. 12

In this lesson personal instruction will be important.

First the use of the patching machine should be explained and studied.

You will notice that this machine will feed in any direction, and that its arm is so made that it will go clear into the toe of a shoe.

In sewing up ribs be sure to have the new stitches follow the old holes, and after sewing place the shoe so that you can take the handle of your hammer and rub down the seam.

In cutting out new back stays, after removing the old one use it for a pattern, and cut the new one just a trifle larger than the old one. Now take a little Climax cement and cement flesh side of the new stay and the part of the shoe it is to be attached to, and when dry place carefully in position and sew on machine, keeping even distance from the edges all around.

If possible, always get the lower edge of your back stay under the vamp and skive it there so that it will not leave a bunch which will hurt the wearer.

To put in an invisible patch in a shoe which has a lining (this usually is a crack or rip in the leather): First cut a patch from a piece of leather somewhat larger than the hole to be patched.

Now take your sharp-pointed knife and, putting one hand inside the shoe, insert the patch between the lining and the upper, finished side out. Be sure that the patch is in smooth and even, then take it to the patching machine and sew it in, sewing through upper, patch, and lining, having your stitches small and zigzag across the rip. Now pound down the stitches, and you will have a neat job of patching.

To cement on a patch outside, skive with a sharp knife all around the hole to be patched, being sure to remove the grain of the leather.

Now, cut your patch out of leather to match the piece you are patching and skive the edges down thin.

Cement both with Union leather cement and let dry. You can tell when it is dry, as it will be white.

In order to apply the patch a little heat will be required. This can be done with a warm iron, or a match will do. If an iron is used, it can be the head of your 8-inch pincer placed where it will get hot. Now, put your patch in position and hold the warm iron against it till it sticks; let it harden for a minute, then pound down smooth with the handle of your hammer or some other smooth tool.

It is necessary, to do this work properly, to have something to fill out the inside of the shoe; either a wooden last or a shoe stretcher will do.

Patching, if done neatly, always commands a good price, and if the student will just take pains he can soon become skilled in this work.

LESSON NO. 13

Practice on patching machine and fitting different kinds of patches.

LESSONS NOS. 14 AND 15

These being the final lessons and not confined to any one subject, the student should select as the jobs to be done in these lessons the work that in the previous lessons has proved hardest for him to do.

Now, that this short course has been completed it is up to its student to continue the work constantly that he may improve the neatness of his work and acquire speed.

The succeeding courses on machine work will probably appeal to many and are of importance to the student who desires to advance himself so as to become a proprietor or manager of a shoe-repair shop.

Rehabilitation monograph. Joint Series No. 31

Unit Course—Shoe Repairing II—Teacher's Manual

MACHINE WORK

February, 1919—Trial edition

1. AIMS OF COURSE FOR STUDENTS

This unit is designed for students who have completed Unit I, or for those who have had experience in the work outlined in Unit I, or those who have had shoe-factory experience but not in the line of shoe repairing.

2. ADVANTAGES TO THE STUDENT

This course provides for continuing instructions and lessons to fit the student to become an operator of shoe-repairing machinery or a proprietor or manager of a shoe-repair shop.

There are many opportunities for capable men to enter this business.

3. TIME REQUIRED

The time allotted to this course is 48 hours, divided mostly into practice periods, as follows:

	Hours
Stitcher unit.....	14
Edge trimmer unit.....	12
Buffing and scouring unit.....	8
Edge setting unit.....	8
Finishing unit.....	6

General instructions in the lessons will be given on machine operation and care of machines, but practice in this course is the essential thing.

In the time allowed here it will be seen that the student will have the practical points explained and that arrangements should be made after the completing of these studies for the student to continue practice of the work outlined.

4. EQUIPMENT NECESSARY

A shoe-repair outfit, to take care of 10 students, should consist of the following machine units:

One stitcher (outer sole).	1 set forepart cutter shields; sizes, 0 to 8.
1 edge trimmer.	12 sharpening wheels, No. 105.
1 scouring section.	12 shank cutters.
1 finishing section.	2 shank cutter shields.
1 edge setter (oscillating).	6 rolls garnet paper, 13/8, FS, grit 1.
1 set of spare parts to be selected.	6 rolls garnet paper, 13/8, FS, grit 0.
1 motor, two-horsepower.	144 sheets garnet paper 9 by 11, grit 1/2.
1 set motor brackets to mount motor on machine.	144 sheets garnet paper 9 by 11, grit 00.
1 dust collector.	500 heel breasters, grit 1/2.
1 gallon medium oil (lubricating).	6 standard 24-pair wooden shoe racks.
5 pounds cotton waste.	12 cakes russet finishing wax (1/4-pound cakes).
1 quart kerosene.	6 cakes black-finishing wax (1/4-pound cakes).
12 pounds 6-cord thread.	2 small granite iron cups for holding edge ink.
8 pounds 7-cord thread.	144 8-inch open-roll finishing covers.
24 pounds white wax No. 2.	6 4-row tooth brushes.
200 needles.	6 1 1/2-inch camels-hair mottler brushes.
100 awls.	2 gallons russet edge and heel ink.
6 No. 2 pillar files.	1 gallon black edge and heel ink.
1 awl-filling clamp or hand vise.	1 edge setting iron, No. 14.
1 peg awl, Haft Star Brand No. 2.	2 edge setting irons, No. 16.
6 peg awls No. 2.	2 edge setting irons, No. 20.
1 pair flat-nose pliers 4 or 5 inch.	2 edge setting irons, No. 22.
2 McKay sewers knives.	2 edge setting irons, No. 24.
12 cutters forepart, No. 14.	1 edge setting iron; shank to follow cutter.
12 cutters forepart, No. 16.	2 gallons light bottom stain.
6 cutters forepart, No. 20.	2 rubber sponges.
6 cutters forepart, No. 22.	2 granite-iron dishes, 5-inch diameter.
6 cutters forepart, No. 24.	

This equipment may be obtained from United Shoe Repairing Machine Co., 4 Albany Street, Boston, Mass., or other reliable dealers in shoe-repairing machines and supplies.

The class should be divided so that two men at a time will be assigned to each unit.

The work of explanation can be done with two men as easily as one. When the time comes for the student to start the practical work the practice period should be divided between them.

The class should be so divided that all units will be at work at one time.

If the class is large, three, or even four divisions may be made so that the whole class can have at least two hours' practice each day.

5. OUTLINE OF LESSONS

Owing to the fact that the class will be divided so that portions of it will be working on different units at the same time, the lessons should also be divided. In this way the part of the class can take up the work of the unit to which they may be assigned. The lessons will not be numbered, but will be named in accordance with the unit of work and the number of hours for each unit given

(1) STITCHER UNIT—OUTERSOLE STITCHING MACHINE

The instructor should explain thoroughly to the student the method of operation of this machine. Show how the awl makes the hole, the needle drawing in the thread, and point out other important motions of the machine.

Insist on the machine being properly oiled and make each student wipe up the machine after using it.

In using wrenches or screwdrivers instruct them in being careful, so that slots of screws and nut and bolt heads will not get burred up. Be sure that the proper size wrench is always used.

Instruct in the care of wax pot; be sure that a fresh, clean supply is always in the pot.

The mode of operating the machine is one for the instructor to decide, and only general rules can be laid out covering this point.

The student should be taught the proper adjustment of the awl and needle, but further adjustments should be taken care of by the instructor. It is not good policy to try to teach machine adjustments while teaching the student how to sew shoes. Fourteen hours of study and practice are allowed for this unit.

(2) EDGE-TRIMMER UNIT

Explain the purpose of this machine and insist on operator taking a natural easy position, with the shoe held firmly in the hands, but with the arms free and easy, so that the shape of the old welt can be followed. Do not allow operator to trim off too much, as by so doing he will trim into the old stitches and make an unsightly job, also spoiling the shape of the shoe.

Instruct in selecting the proper size cutter and shield; also on keeping cutters in good condition.

When first starting to work on this machine dull up the cutter by drawing the back of a knife blade across the teeth. After the student has become familiar with the machine and knows better how to handle the shoe, a sharper cutter can be used. Twelve hours are assigned to this unit.

(3) BUFFING AND SCOURING UNIT

Natural easy position is important in this work also, and the shoe held firmly in the hands with the arms free.

Instruct in putting scouring paper on the wheels and rolls properly, so that it will be firm and without wrinkles.

A loosely put on paper will not wear nearly as long as one properly put on.

This unit comprises heel scouring with coarse and fine paper. Heel breast scouring one grit paper and bottom buffing with two grits of paper.

Impress on the student the importance of neat, careful work, as a poorly scoured heel and a poorly buffed bottom will never finish up properly. Time allowed, eight hours.

(4) EDGE-SETTING UNIT

This unit is important in that a well set and finished edge is always the earmark of good shoe repairing. Have edge ink in proper temper before attempting to set, and do not allow the iron to be too hot. Any easy position is important in working out this unit. Time allowed, eight hours.

(5) FINISHING UNIT

This unit is designed to finish and polish heels, shanks, and bottoms. It is not necessary to demonstrate the many kinds of fore-part finish that might be obtained; a simple method of light stain for fore part with black or chocolate shank makes a neat and easy method for finishing repaired shoes.

Have heels inked in and instruct students in having ink in proper condition before attempting to burnish. Always finish breast of the heel in same color as shank. Time allowance for this unit, six hours.

FINAL WORD TO THE TEACHER

The student having now had instructions and practice on the various units, it is up to him as to what advantage he wishes to make of the knowledge gained.

It is desirable that he be allowed to continue his work along these lines, as he will not be gaining experience and will lose a certain amount of the skill attained in these lessons if he does not have the opportunity to keep his hand in practice.

6. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers, under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating such subjects as shoe repairing are available, it is recommended that final rating be recorded as follows: The average student will be rated "good"; the student of exceptional ability will be rated "excellent," while the student of lesser ability will be rated "fair." The student producing work of a quality that would be rejected in the commercial shop should be rated "poor."

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

(a) *Time*.—Is the student rapid, moderate, or slow in executing his work?

(b) *Technique*.—

Does the student use workmanlike methods?

Does he exercise reasonable economy in use of materials?

Is he neat and orderly in care of tools?

(2) Finished product:

(a) *Accuracy*.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.

(b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.

(c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

(a) *Attitude toward work*—

Does the student love his work or does he watch the clock?

Is he likely to continue in this line of work?

(b) *Studiosness*—

Does the student show disposition to study the printed literature related to this work?

Does he express a desire to take advanced unit courses in this or related subjects?

(c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?(4) *Test problem*.—A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

MACHINE WORK.—STUDENT'S INSTRUCTION SHEETS

NOTE.—These student's instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

In beginning this course you should understand that a course on machine shoe repairing can only be outlined in printed form. In the following lessons general rules for you to follow will be given, but it is impossible for you to study any given lesson and gain from it the art of operating shoe-repair machinery without performing the actual practice work.

The time allowed for the different units in this course should be devoted to practice and it should be remembered that after you have become acquainted with the principles of operation and gained the idea of how to operate each unit, further practice should be provided for beyond the time allowed.

It is possible where conditions warrant that after completing these units you might be placed in a shoe-repair shop conveniently located where you can continue the work under practical conditions.

Bear in mind that you can learn from observation, and while the instructor is showing you how to hold the shoe, or the proper position to take at the machine, you should give him your whole attention.

Nothing is more discouraging to an instructor than, after having spent some time in demonstrating some problem, to turn around and find that the student is looking out of the window or is otherwise inattentive.

You should also observe your fellow students, as you can learn much from them, as the mistakes they make will be more apparent to an observer than to themselves.

STITCHING MACHINE

This machine is used for sewing soles or half-soles to the welt. You will note that the machine is fitted with a wax pot which is filled with hard white wax and is so constructed that heat is applied to it to melt the wax.

The thread passes through the hot wax becoming saturated with it before being drawn into the shoe. This preserves the thread and makes it hold tight in the leather.

The machine is fitted with an awl and needle.

The awl makes the hole and feeds the shoe along for the next stitch.

The needle takes the thread, drawing it through the hole made by the awl, and brings it into position in a loop which is drawn over the shuttle.

This is called a lockstitch, that is a series of stitches, each one of which is a unit in itself.

Two threads are used in lock-stitch machines, one in the machine proper and the other in the bobbin which is inside the shuttle.

No machine will run well unless properly oiled and supplied with fresh, clean wax in the wax pot. So, before starting to work, always first see that there is a good supply of wax in the pot, and second, oil the machine thoroughly. Go over it to become familiar with the places which should be oiled. These places will be carefully pointed out to you by the instructor and care should be used in oiling to see that the oil reaches the oil hole properly. One drop of oil in the oil hole is better than half a can full put near the hole.

The machine must be hot before attempting to sew on it. Wax must not only be hot, but the machine head proper must be hot or the thread rolls will be stiff, causing thread breakage.

When the point of the awl reaches a condition where it will not go through the work straight it should be changed. The machine will never sew properly with a bent awl and much time will be lost in attempting it; this will also cause needle breakage.

Care should be taken in adjusting the awl and needle, because if they are improperly set the machine will not sew. The instructor will give individual instruction in these adjustments.

In operating this machine assume an easy, natural position; do not hold yourself stiff.

The treadle which operates the friction pulley and causes the machine to run should be operated with the left foot. Therefore, this foot should be extended forward just enough so that you are not out of balance. The heel of the left foot should rest on the floor and the treadle should be operated by pressing on it with the ball of the foot.

Remove the bobbin case from the machine and take the thread out of the looper, then practice running the machine without any work in it. Note that the harder you press the treadle the faster the machine runs. Try getting different speeds and stopping the machine.

The instructor will give you directions for holding the shoe in the machine and the proper positions for the hands.

Hold the shoe firmly in the hands but have the arms free, not stiff, and don't push on the shoe.

The shoe should be held flat; do not rock or tip it as this will bend the awl, break needles, and cause uneven stitching.

Do not force the shoe along or hold it back; the machine will feed it along evenly if it is held properly.

Time allowed, 14 hours.

EDGE TRIMMER UNIT

This machine is used to shape the soles of the shoe and leave a smooth even edge.

This is done by means of a cutter having 16 teeth which revolve at high speed, the shoe being placed against the teeth of the cutter and drawn toward you, following the contour of the old welt.

A shield is provided which goes against the face of the cutter, and should be large enough in diameter to just cover the lip of it.

The shank cutter is designed to give different shape to the edge of the shank, and is used only on that portion of the sole.

You should take a natural, easy position at the machine, with left foot extended to the front and the right to the rear, so that you are not out of balance.

Hold the shoe firmly in the hand with arm free and easy.

The shoe should be held so that the sole is facing the machine and the upper away from it. Start at the breast of the heel and trim the shank up to the ball on the shank cutter.

Then with the forepart cutter trim from ball to ball, going in one direction always and drawing the shoe toward you. The welt side of the edge should always be held against the shield. Do not make a short choppy motion. When you start at the ball draw the shoe against the knife clear up to the toe.

Do not then push the shoe against the cutter. After you have gone from ball to toe, with one motion take the shoe away from the cutter and start at the ball again, repeating as many times as necessary to take off the surplus stock down to the welt.

In trimming around the toe hold the shoe firmly with the hands as near the toe as possible, and draw the shoe clear around the toe from one side to the other, always drawing it toward you. Then trim from toe to ball on the other side with the fore-part cutter. Next finish the shank from ball to heel on the shank cutter.

To get the best results a shoe should be trimmed twice.

First trim dry, taking off just enough surplus leather to shape up the shoe well, then with a brush wet the edge with water and let it set while you are rough-trimming the other shoe.

For the second trimming the shoe should be held lightly against the cutter and carried all the way around the sole with as few motions as possible. This will give a smooth, even edge that will finish up well.

Be sure to keep the edge of the sole at the same angle on the cutter all the way around. Always work from the lowest point of the cutter; never allow yourself to trim an edge on the front of the cutter. If you tip the shoe over to one side or the other you will have edges that will not be square.

Time allowed, 12 hours.

BUFFING AND SCOURING UNIT

The edges having been trimmed it is the purpose of this unit to scour the heels preparatory to finishing. For this work two grits of paper are used, coarse and fine. The coarse is used to shape up the heel and the fine to finish up.

To get good results the paper should be put on the wheel tightly and also evenly. It should not overlap on the edges of the wheel or the uppers of the shoes will be cut.

The wheel should be opened and the end of the paper inserted and fastened evenly over the brads, then draw the paper around the wheel evenly and just tightly enough so that you can close the wheel without tearing the paper. A loose paper will wear out quickly and it will also slide on the roll from side to side with the danger that it will cut the uppers. Be sure that the wheel is properly locked before starting the machine.

The shoe is held firmly, using the left hand at the counter and resting the breast of the heel on the thumb and first finger of the right hand, using these as a rest.

The work should be done by starting at the breast of the heel and carrying it around on the wheel to the other breast. The heel should be held firmly against the scouring wheel and should be kept turning all the time; if you hold the shoe still against the wheel you will scour a flat place in the heel. The shoe should be turned in sweeps, the first carrying you from the breast to the center back of the heel, and then from the center to the other breast. Short sweeps will fill the heel full of little ridges.

These instructions are the same for coarse and fine paper. In holding the shoe the left hand should be so placed that the fingers can squeeze in the counter at the breast of the heel and along the heel seat so that the scouring paper will not cut the upper of the shoe.

The heel should be held flat against the face of the wheel and should be scoured just enough to get a smooth surface.

This work being done on repaired shoes the portion of the heel which has been repaired is what should be scoured the most. Do not scour the portion of the old heel but very little, as it will tend to make the heel smaller and this is very objectionable to most people.

The heel should be kept moving rapidly against the scouring wheel for if moved too slowly you will burn the leather and a good finish can not be obtained.

BOTTOM BUFFING

The paper on these rolls should be on tightly and evenly as on the scouring wheels.

Loosen the cams, open the rolls, and attach one edge of the sandpaper to the brads then draw the paper around tightly and fasten it to the brads on the open side of the roll. Now close the roll and tighten the cams.

You should not attempt to buff the bottom of a shoe that is not thoroughly dry.

First use the coarse paper, drawing the shoe from heel to toe with a slightly circular movement. Do not hold the shoe too hard against the roll; keep it moving or you will scour deeper in one place than you will in another, or you may burn the leather.

Buff lightly as only the grain should be removed; if you buff too much on the coarse paper you will fill the sole with scratches, which, if you buff out on the fine paper, will take you down into the rough part of the leather and a good job of finishing can not be done.

Use the fine paper lightly, just enough to take out the marks of the first buffing, and use the same motion.

HEEL-BREAST SCOURING

The work should be done on the bottom side of this wheel.

Hold the shoe by the counter with the left hand, the right hand grasping the fore part. Start at the side of the heel nearest to you and draw the heel across the wheel toward you with a motion that follows the contour of the breast of the heel. Repeat the motion two or three times till the breast is smooth.

Time allowed for this unit, eight hours.

EDGE-SETTING UNIT

The shoes coming to this machine have had the edges trimmed and the heels scoured, and the object of this machine is to set or burnish the edge preparatory to finishing.

First stain in or ink the edge. Always be sure that the blacking is well stirred or shaken up. The dish that it is kept in should be clean and should be washed out every night. Any blacking left in the dish at night should be turned back into the jug or barrel and the dish and brush washed. Good edge setting can not be obtained with dirty edge ink.

The best brush to ink in edges with is a four-row toothbrush.

Take as much ink on the brush as it will hold without dripping, and, holding the shoe by the upper in the left hand with the edge up, start at the breast of the heel and, with the brush held squarely against the edge, turn the shoe with the left hand, following the edge around to the other heel breast with the brush held in the right hand.

Have the ink even on the edges and be sure that all of the edge is covered.

The edges should be dry before inking in; good results can not be had on wet edges.

Ink in all the shoes on the rack and allow them to dry before setting the edges.

Practice will tell you at what temper they will set best, and no hard and fast rule can be laid down to cover this point. Some ink will dry out faster than others, and the weather has a bearing on this, too, as ink will dry slowly on a cold, damp day.

A fairly good rule to go by is that the edge will set well when the blacking is dry enough, so that it will come up to a polish when the thumb-nail is drawn across it.

The proper iron should now be selected and placed in the machine.

The edge should always be set with the same style and size of cutter that the edge is trimmed on. In some cases this size is marked by the edge trimmer on the shoe tag, but this is not necessary, as you can always tell the correct size by holding the shoe edge up and placing the iron on the edge, and you can readily determine the proper size, as it will fit exactly onto the edge. The shank iron is so constructed that only one size is used.

Apply the heat to the iron, and do not allow it to get too hot, as it will burn the blacking and will not bring it up to a glossy finish.

If the iron be too cold, it will make the work very hard and the blacking will roll up in front of the iron. You can tell easily when the iron is at the right heat, as it will work easily on the edge and the ink will work up to a bright, even finish.

Never take a short, choppy stroke in drawing the edge against the iron. Start on the shank at one side and move shoe from breast of heel to the ball at one sweep, going over it several times. Hold shoe firmly against the iron.

The same should be done on the forepart iron, going from ball to toe at one sweep. Eight hours are allowed on this unit.

FINISHING UNIT

This unit is designed to finish the heels, shanks, and bottoms. Shoes come to this unit with the edges set, the heels scoured, and bottoms buffed.

First ink the heel, using a 1½-inch camel's-hair flat brush. Be sure that the brush and receptacle are clean, and in putting on the ink be sure that the whole heel is covered and that the ink is on even. Carry as much ink in the brush as it will hold without dripping.

Ink in the edge, breast, and top lift at one time. In inking in the top lift take care that the ink is spread evenly; do not let it be streaked. Go over the top lift twice, first in straight motions from breast to back of heel, then straight across from side to side.

After the ink has dried enough so that it will come up to a polish when rubbed with the thumb-nail, burnish it on the heel burnishing wheel, using the same motion as is used in scouring the heel.

The heel-burnishing wheel is of corrugated rubber and should be covered with cloth. The open roll covers are designed and made especially for this, and they should be put on tightly and smoothly. A loose cover will wear out quickly and will not give a high luster.

Use a little finishing wax on the cloth. When the wheel is revolving hold the cake of wax against the face of the wheel and friction will cause enough wax to be taken onto the cloth so that a bright glossy finish will be obtained.

Do the same on the heel brush, and after burnishing the heel and top piece, finish up on the brush.

Next finish the forepart.

The dishes and sponges used for this work should be cleaned each day and any stain left in the dish should be thrown away. Always figure your work so that you have just enough stain to complete your work in hand so there will be no waste. The stain in the jug should be well shaken up before being used.

The shoe should be taken in the left hand and with a short-bladed, sharp-pointed knife cut a curved line from ball to ball, holding the knife slanted toward the forepart of the shoe. This will raise a little flap of leather which serves as a dividing line between the forepart and shank. Be sure in cutting this line that the same shape is attained on each shoe. This requires a good eye, but practice will bring its reward, and you will be able to make the lines so near alike that it will be almost impossible to detect any difference between them.

Now moisten the sponge in the stain, wetting about half of it. Do not have it too wet, but get enough stain into it so that you can go over one forepart without having to stop to wet the sponge a second time.

Now take the shoe with the left hand taking hold of the upper, and, with the sole up, draw the sponge quickly from side to side across the ball line; take care to get as little as possible of the stain on the shank part. Then finish the balance of the forepart by drawing the sponge from the wet portion toward the toe. This must be done quickly, for if the stain dries before being brushed up you will have a streaked bottom.

As soon as you have covered the forepart with stain lay down the sponge and draw the forepart across the bottom finishing brush until it is dry. Care should be taken in putting on the stain to keep it off the edges. When brushing the forepart up to a polish on the last brushing, tip the shoe and turn it on edge, so that any stain which may have gotten on the edge will be brushed off.

To obtain a high luster to the forepart, a little brush polish may be rubbed on the brush, then brush the bottom lightly and finish on a yarn or seersucker brush.

To finish the shank a 1½-inch camel's-hair brush should be used. The same ink is usually used as for heels.

Take as much ink as the brush will carry without dripping, and, holding the shoe by the upper with the left hand, sole up, draw the brush across the shank from side to side, starting at the ball line and following the shape of the cut which you have made to separate the shank from the forepart. The little flap of leather which is laid up when making this cut will aid you in getting a good line and also in keeping the ink off the forepart. This is best done by setting one edge of the brush on the shank and giving a twisting motion to it, which will allow just the tip of the other edge of the brush to follow the ball line.

Finish the inking of the shank by going first across it from side to side, then lengthwise, then across again. This is to lay the ink smooth and without brush marks.

After the ink is dry burnish on the shank wheel and brush up on the shank brush.

If a little wax be put on the brush and the shoe held lightly against it, a very high polish will be obtained.

Time allowed, six working hours.

FINAL WORD TO THE STUDENT

Shoe repairers are in constant demand, and there is no doubt but that, with the fundamental knowledge which you have attained during these lessons, you would now be able to take up the work in a commercial shoe-repair shop, not, perhaps, as a finished workman but with a knowledge of the work which with practice would develop you into an expert.

Rehabilitation monograph. Joint Series No. 32.

Unit Course—Electricity I—A Short Unit Course for Installing Electric Call Bell Equipment

BELL WIRING

February, 1919—Trial edition

PART I. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course may be taken by a student whose education is limited to the first six years of the elementary school, and who is physically able to perform the tasks specified. While the

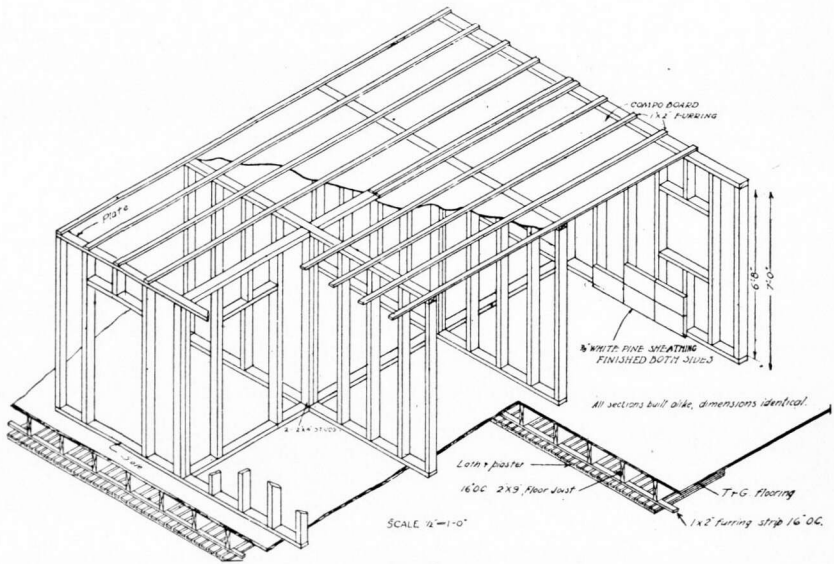


FIG. 1

subject has a fascination for the average man, the student should give evidence of an interest in the subject beyond mere curiosity or entertainment before being permitted to enter upon the course. In other words, he should have a serious purpose in taking up the subject.

ADVANTAGES TO BE DERIVED BY THE STUDENT

This course will enable the janitor or home owner to judge the quality of work done by others or to acquire sufficient skill for installing simple bell-signal equipment. Soldiers whose occupations before entering the Army were unprofitable or uncongenial, who felt that they were failures in the work they had selected, may try again in a new field with the possibility of success.

The unit is the beginning of several courses in electrical wiring and installation. The student who masters the details of this unit will have made an excellent start toward a thorough training as an electrical mechanic, an occupation in which workers are well paid and rarely unemployed.

3. LENGTH OF THE COURSE

It is estimated that the average man can complete this unit course in 16 hours of study and practical work.

4. EQUIPMENT AND MATERIALS

The structure described in the drawing shown in Figure 1 is recommended to be built in a room not less than 25 feet wide, 40 feet long, and 10 feet from floor to ceiling. This room should also be equipped with a closet under lock and key provided for the convenient arrangement of tools and electrical supplies.

If it is possible to obtain an old private residence for the work, the conditions would be ideal. Should this be impossible, the equipment may be installed in an apartment or even in a single room of an apartment or residence.

The tool equipment should include both individual kits to be provided for each student and a general outfit of tools less frequently used, which may be shared by the whole class.

Individual kit:

1 pair 7-inch side-cutting pliers.	1 single-blade jackknife.
1 No. 13 bell-faced nail hammer.	1 drawing board, $\frac{7}{8}$ by 18 by 24 inches.
1 $2\frac{1}{2}$ -inch Champion screw driver.	1 brad awl.
1 midget (Valley Pet) screw driver.	

General tools and equipment (recommended for a class of five students. Vary the number of each item according to the size of the class).

2 5-foot spreading stepladders.	1 flat file, 8 inches long.
2 $\frac{1}{16}$ -inch auger bits.	1 6-inch try square.
2 $\frac{1}{8}$ -inch auger bits.	2 $\frac{5}{16}$ -inch star drills.
2 $\frac{3}{8}$ -inch auger bits.	1 hack-saw frame.
2 $\frac{1}{2}$ -inch auger bits.	12 8-inch hack-saw blades.
2 ratchet braces, 8-inch sweep.	1 16-inch crosscut handsaw.
2 $\frac{1}{2}$ -inch bell hangers' bits, 18 inches long.	1 16-inch rip handsaw.
2 12-inch compass saws.	1 steel block plane.
2 $\frac{1}{2}$ -inch wood-cutting chisels.	100 feet $\frac{1}{8}$ -inch standard fish wire.
2 1-inch wood-cutting chisels.	2 extension bit holders.

The amount of supplies recommended for a class of five students during a period of 16 hours is as follows:

15 pounds No. 18 B. & S. gauge annunciator wire in assorted colors.	1 gross $1\frac{1}{2}$ -inch No. 5 flathead brass wood screws.
15 pounds No. 18 B. & S. gauge damp-proof office wire in assorted colors.	24 $\frac{1}{8}$ by $\frac{3}{4}$ inch lead expansion sleeves.
3 pounds $\frac{3}{8}$ -inch flathead staples.	24 $\frac{3}{16}$ by 4 inch Ajax toggle bolts.
1 gross $1\frac{1}{2}$ -inch No. 5 flathead bright wood screws.	15 $2\frac{1}{2}$ -inch adjustable vibrating bells.
1 gross $\frac{3}{4}$ -inch No. 5 flathead bright wood screws.	15 wood push buttons.
1 gross $1\frac{1}{2}$ -inch No. 5 round-head blued wood screws.	5 wrought-bronze loose-sack push buttons.
1 gross $\frac{3}{4}$ -inch No. 5 round-head blued wood screws.	6 carbon cylinder salammmoniac battery cells complete.
1 gross $1\frac{1}{2}$ -inch No. 5 round-head brass wood screws.	6 pencil zincs.
	10 No. 6 dry-battery cells.
	5 pounds $\frac{3}{4}$ -inch friction tape.
	12 soft-lead pencils.

It is suggested that "Menominee" bells be used because they readily lend themselves to the job of taking apart and reassembling. The Menominee Electric Co., 152 Chambers Street, New York City, makes this bell.

5. STANDARDS FOR MEASURING AND RECORDING STUDENTS' WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shopwork are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

1. *Execution of work*

- (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
- (b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

2. *Finished product*

- (a) *Accuracy*.—Should be determined by the record kept of errors in measurement, etc.
- (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

3. *Interest*

- (a) *Attitude toward work*.—Does the student love his work, or does he watch the clock? Is he likely to continue in this line of work?
- (b) *Studiosness*.—Does the student show disposition to study the printed literature related to his work? Does he express a desire to take advanced unit courses in this or related subjects?
- (c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

4. *Test problem*

A test problem might be given at the conclusion of the course which would involve all or most of the fundamental points covered by the course.

6. LESSONS OR JOBS

1. Study of a vibrating bell; time, 30 minutes.
2. Connecting a vibrating bell; time, 1 hour.
3. Bell trouble; time, 1 hour.

4. Tracing and removing bell trouble; time, 1 hour.

5. An exercise in exposed bell wiring; time, 1 hour.

(Lessons 6 to 9 comprise a problem of installation of a front entrance electric call bell for a private residence.)

6. Location of outlets; time, 30 minutes.

7. Installing wires, exposed method; time, 3 hours.

8. Installing instrument, device, and battery; time, 1 hour.

9. Testing out the job; time, 1 hour.

(Lessons 10 to 12 comprise a problem of installation of a front entrance call-bell equipment in a two-family wooden frame house.)

10. Locating the outlets; time, 1 hour.

11. Providing unobstructed runways between outlets and fishing wires; time, 3 hours.

12. Installing instruments, devices, and battery, testing and connecting wiring; time, 2 hours.

7. SUGGESTIONS FOR CONDUCTING THE COURSE

The instructor conducting the course is urged to study carefully the lessons, installations, and job which compose the unit. It is desirable that the instructor be an electrical worker with at least five years' experience in construction work. He should bear in mind that construction principles or methods vary with local requirements. Large cities generally demand a higher standard of workmanship than small communities, for what may be considered good work in a rural town or mining camp, in a large city would be condemned as the work of a "salammoniac disturber." In conducting the course, ample latitude is allowed for the expression of the instructor's training and experience. It is most important that the aim be so to adjust these lessons to local conditions as to carry over to the student in the limited time knowledge and skill of immediate practical use.

Lessons 1, 2, 3, 4, and 5 may be assigned to students as bedside occupations. They are, however, not designed for bedside work alone. Each student should take them as preliminary to the installation jobs.

The instructor will observe that each lesson and job is complete in itself, gives instructions for conducting the work, reference for study, questions for further study, and a statement of the time required to complete it. The time is estimated upon the basis of experience in teaching young men whose education has been that of the elementary school. Here again no hard and fast ruling is desired. The time may reasonably be accepted as a basis in rating the student as to speed. Care should be taken to avoid the assignment of a task the length of which is greater than the time at the disposal of the student. The longer jobs may be worked together by two students. This will eliminate lost time and waste in material.

The lessons and jobs lend themselves to individual instruction rather than class instruction. Class instruction is advantageous in matters of general interest applicable to the work. A "shop talk" may be created on the foundation of any question that may arise in the series of lessons. The duration of a shop talk varies with the topic. A short shop talk of from five to ten minutes is more desirable than an extended one.

8. LIST OF BOOKS USED WITH LESSONS AND JOBS

The average person will welcome a book to obtain knowledge of electrical phenomena. These books are provided to encourage the student to read and consult them frequently. Aside from the interest of the subject matter, the actual reading carries over the conviction that the work the student seeks to master will have a definite value in terms of money. From the books listed a number of sections may be selected for supplementary study.

Make a tactful and thorough study of the physical condition of the student, his mental ability, his needs, aims, and purpose. Select for reading only the material which you know he is capable of digesting and actually needs to make good. Should a student show an inclination and ability for further study, assign more than the average book work, but in every such case be sure the lessons and jobs are not shirked.

Timbie, W. H.: *Essentials of Electricity*. John Wiley & Sons (Inc.), New York, 1914. \$1.25. An exceptionally interesting and understandable description of the flow of electricity.

Croft, Terrell: Practical Electricity. McGraw-Hill Book Co. (Inc.), New York, 1917. \$2.50. A definite amount of information on electromagnetism is required to understand the operation of an electric bell. Pages 140-149 are a splendid source of information. For supplementary reading there is no better book published on the subject of electricity.

Croft, Terrell: Wiring of Finished Buildings. McGraw-Hill Book Co. (Inc.), New York, 1915. \$2. Although in these pages the reading recommended describes electric-light wiring, the methods followed and tools used are the same as for bell wiring.

Croft, Terrell: American Electricians' Handbook. McGraw-Hill Book Co. (Inc.), New York, 1914. \$3. Section 4 on interior wiring is so helpful to the student of modern building equipment that no study of electrical installation would be complete without the store of information and suggestions it contains.

BELL WIRING

PART II.—STUDENTS' INSTRUCTION SHEETS

These Students' Instruction Sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the Students' Instruction Sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

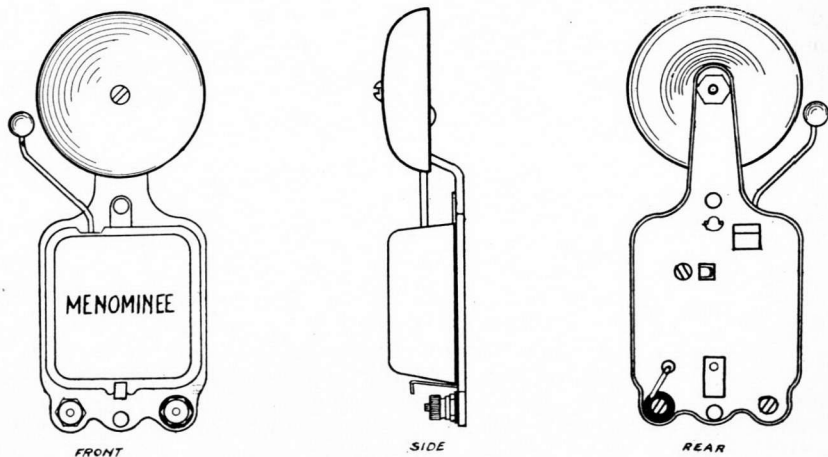


FIG. 2.—Vibrating bell

The study of a vibrating bell

Lesson I

This vibrating bell is commonly used in apartment and private houses for call-bell apartment. The parts and their uses are here described. Compare the bell which you have with Figure 2.

Parts	Purposes
A stamped metal base.....	To hold all parts so that they will work properly.
A stamped metal gong.....	To produce a ringing sound.
A yoke.....	To hold magnet cores, armature, and insulated adjusting post in place.
Magnet cores.....	To provide a path for magnetic circuit.
Electromagnet coils.....	To provide a path for the electric current to create the magnetic circuit.
Armature with spring, rod, and tapper.....	To be attracted toward the magnet cores when current flows through electromagnet coils so as to strike gong intermittently.
Insulated adjusting post.....	To provide an insulated support for the adjusting screw and one wire from the electromagnet coils.
Adjusting screw.....	To keep proper spacing between platinoid point of screw and platinoid disk on armature spring.
Grounded binding post.....	To fasten wire from one side of electric circuit and conduct current to platinoid disk on armature spring.
Insulated binding post.....	To fasten wire from other side of electric circuit and conduct current to electromagnet coils.
Stamped metal box.....	To cover the working parts so as to protect from injury.

Learn to know the parts so well that you may be able to take the bell apart and then reassemble it.

In the meantime it will be well for you to know a little about electricity. Ask for W. H. Timbie's *Essentials of Electricity* and turn to page 1. Read paragraphs 1 to 4 fully until you understand the flow of electricity.

Time.—A man should complete this study in 30 minutes.

Lesson II

The previous lesson and your study of the flow of electricity have prepared you for an experiment that will show you how to make the bell ring. Using the same vibrating bell, some wire, a dry battery, and the tools given, follow directions:

Tools and equipment.—One vibrating bell, one wood push button, six feet of No. 18 annunciator wire, one dry cell or battery, one pair of 7-inch side-cutting pliers, one 2½-inch Champion screw driver, one midget (Valley Pet) screw driver, and one single-blade jackknife.

Directions for connecting a vibrating bell and battery.—Divide the wire into two equal lengths and cut the loop with pliers. Do this again with one of the two lengths. You now have one 3-foot length and two 1½-foot lengths. "Skin" about 1 inch of insulation off the ends of each length with the jackknife, holding the knife and the end of the wire as you would when sharpening a pencil. Gradually shave the insulation off until the copper surface of the wire is exposed. Avoid cutting into the copper wire so as to score or nick it. Scoring or nicking lessens the strength and current-carrying capacity of the wire.

With fingers or pliers loosen the knurled round nuts on binding posts of bell and battery. Take the long wire and connect one bare end to one binding post of the bell and the other end to one binding post of the battery. This is called the "bell battery wire." Take one of the short wires, connect one end to the remaining binding post of the bell and the other end push through a hole in the base of the push button—from which first remove cap and button—and connect to one binding screw. This is called the "section wire." One end of the remaining short wire attach to the unconnected binding post of the battery, the other end attach to unconnected binding screw of the push button in the same way as you did with the section wire. This is called the "button battery wire."

Take care when connecting wires to binding posts or screws of bell, battery, and push button, that the bared ends are turned around under knurled nuts of binding posts or heads of screws in the direction that the nuts and screws are turned to tighten. This is the right-handed thread motion. Wires turned in the opposite direction will tend to loosen and create poor connections.

Observe that the binding screws of the push button connect the wires to contact-making springs. Press down the upper spring so it touches lower spring and the bell should ring. Remove the box from the bell and watch the action of the armature moving toward and away from the magnet cores. Also take note of the sparking where the point of adjusting screw comes in contact with the end of armature spring.

An understanding of the power produced when the electric current flows through the electromagnet coils of the bell is valuable. Ask again for that book: W. H. Timbie, *Essentials of Electricity*, and turn to page 124. Read paragraph 55 to the bottom of page 126; then turn to and read paragraph 110 on page 228.

Time.—A man should complete this study in one hour.

The working parts of a vibrating bell and bell "trouble"

Lesson III

A bell may at any time reveal a defect due to manufacture, hard service, or accident. This defect may appear in two ways. The bell will either not ring at all or very poorly. This condition is called bell "trouble." In this lesson take the bell apart, reassemble it, and try to create "trouble."

Tools and equipment.—One vibrating bell, one wood push button, 6 feet No. 18 annunciator wire, one dry cell of battery, one pair of 7-inch side-cutting pliers, one 2½-inch Champion screw driver, one midget (Valley Pet) screw driver, and one single-blade jackknife.

Directions.—With the screw driver and pliers remove the parts from the base of the bell in the following order: (See fig. 3.)

With screw driver draw back the spring holding the box and lift the box off. Observe that the insulated binding post is the one to which the wire from the electromagnet coil is attached. With screw driver and pliers remove this binding post from the base and be careful to hold the insulating washers and nuts for they are easily lost.

Take off the yoke by removing the screw on the back of the base. Next withdraw adjusting screw from the insulated adjusting post and release the magnet wire lug. Then disconnect the wires that join the two electromagnet coils. Unfasten the electromagnets by removing screws which hold them to the yoke.

Remove the armature if it is attached to the yoke with small screws. If the armature is attached with rivets, remove only when extra screws or rivets are supplied. Remember that the rivets you remove can not be used again.

All the working parts are now separated. Begin to carefully replace all of the parts. When the bell is reassembled connect it up with the battery and push button and test it.

If the bell rings as well as before taking it apart you have reassembled it properly. If it fails to do this or does not ring at all you have created "trouble." The removal of this "trouble" will be your next lesson.

It will interest you to know just how the current that flows from the dry battery is produced. You will find this described in W. H. Timbie's *Essentials of Electricity*, pages 194-196, paragraphs 89 to 91.

Time.—A man should complete this job in one hour.

Tracing and removing bell "trouble"

Lesson IV

The electrical worker engaged in bell equipment spends a good deal of time in tracing and removing bell "trouble." This is called "trouble hunting" or "trouble shooting."

Tools and equipment.—A defective vibrating bell, 6 feet of No. 18 annunciator wire, one dry cell of battery, one wood push button, one pair of 7-inch side-cutting pliers, one 2½-inch Champion screw driver, one midget (Valley Pet) screw driver, and one single-blade jackknife.

Directions.—Connect the wires to the binding posts of the bell and battery and to the binding screws of the push button, just as in Lesson III. Disconnect the wire attached to the insulated binding post of the bell, press the push button and touch the bared end of this wire to the insulated binding post and quickly withdraw it. Do this several times. Does the wire draw a spark each time? If so, the bell is either "short circuited" or the tapper is held rigidly against the gong.

First, with your fingers, clear the tapper away from the gong, then test as you did at the start. If the "trouble" remains the bell is "short circuited." A short circuit results from the contact of two wires containing electric currents of opposite polarity. If allowed to remain a "short circuit" will rapidly run down or exhaust the battery. Proceed to find the "trouble" by examining the insulated binding post. The binding post may be in contact with the base between the rear and front insulating washers. Loosen the binding post and carefully replace it free from contact with the base and be sure the wire from the electromagnet is attached and insulated from the frame. Test the bell again. It should ring.

If the bell fails to ring when connected and, in testing, no spark is drawn, the bell is "open circuited." An open circuit is a break in the wiring or connections which causes the current to stop flowing. Connect the section wire to the insulated binding post of the bell. Disconnect the bell battery wire from the other binding post of the bell. Press the push button and touch the bared end of the wire to the twisted wires between the electromagnet coils. The tapper should strike the gong once each time a contact is made. If it fails, first examine the magnet wire run back of base to the insulating binding post. It may be disconnected. Connect it and test the bell.

Even after doing this the tapper may fail to strike the gong. Now look for a broken wire often found where the magnet wire leaves the electromagnet coil. If the outside wire

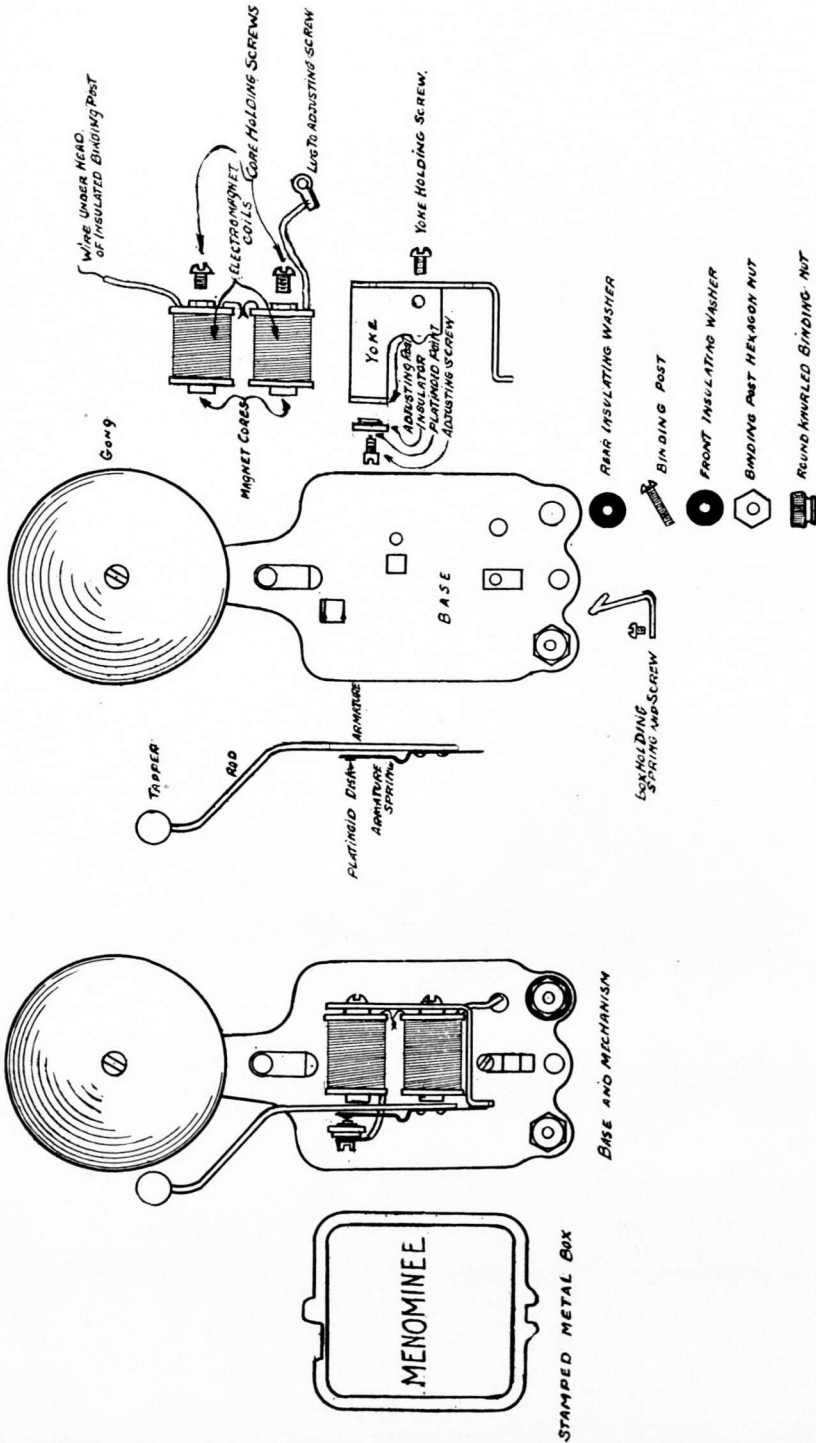


FIG. 3.—Parts of a bell

is broken unwind one full turn and reconnect. If the inside wire is broken unwind and then rewind the entire electromagnet by hand, leaving a few inches of connecting wire at each end. If found necessary, after testing the other electromagnet in the same manner, repair it in the same way.

A bell will sometimes fail to ring because the platinoid point of the adjusting screw does not touch the platinoid disk at the end of the armature spring. Turn the adjusting screw inward or press armature spring outward a little to make contact.

Another kind of "trouble" is shown when a vibrating bell rings "single stroke," that is, when the tapper strikes the gong once each time the push button is pressed. In this case examine the twisted wires between the electromagnets. If the bared ends touch any part of the yoke or base, remove them from contact. Or examine the wire leading to the lug under the adjusting screw. Should any bared part of this wire touch the base, yoke, or adjusting post, remove and insulate it before reconnecting.

A description of the different kinds of bells used for bell equipment will be found in W. H. Timbie's *Essentials of Electricity*, beginning on page 227. Study paragraphs 109 to 114 and become familiar with same.

Time: A man should complete this job in one hour.

An exercise in exposed work bell wiring

Lesson V

The wiring in finished houses is generally fastened to wood supports such as door and window trim, base board, wainscot, and picture molding that may be found to provide a path between the bell, push button and battery. The wires are fastened with double-pointed tacks called electrician's staples.

Tools and equipment.—A drawing board of $\frac{7}{8}$ -inch white pine 18 inches wide and 24 inches long, 10 feet of No. 18 annunciator wire, 1 dozen $\frac{3}{8}$ -inch flat-top staples, four $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws, one vibrating bell, one wood push button, one dry cell of battery, one round lead pencil, one $2\frac{1}{2}$ -inch Champion screw driver, one midget (Valley Pet) screw driver, one pair of 7-inch side cutting pliers, one No. 13 bell faced nail hammer, and one 5-foot zigzag rule.

Directions.—Lay out your work according to the diagram shown in Figure 4. Do the wiring first. With the rule measure the distance between the binding posts of the bell. Measure the length of the bell. Allow an inch more than the length and, measuring down from the upper left-hand corner of the drawing board and inward from the left side about 2 inches, place two lead pencil marks indicating the distance measured between the binding posts of the bell.

Before fastening the wire to the board be sure to straighten it by removing all kinks and twists. At a point 6 inches from the end (allowed for the helix) lay the wire on the board over the lead pencil mark nearest the edge. At this point drive a staple.

Drive staples over the wire just sufficient to hold it in place and not to injure the conductor of its insulation. Drive the staples straight down over the wire. Avoid spreading or driving them sideways. Continue the work as laid out on the diagram, leaving 6 inches of surplus wire for helix at bell and battery and 3 inches at the push button.

"Skin" the insulation at least 1 inch from the ends of the surplus wire for connection to bell and battery binding posts and under the binding screws of the push button. Make a helix by turning the surplus insulated wire around the lead pencil. No helix is required at the push button.

Set the bell fast to the board with the wood screws and connect the wires to the binding posts. Remember that the wires must be turned in the direction that the knurled nut turns to tighten. Remove the cap and button from the push button, thread the wires up through the holes in the base—not the countersunk holes for screws fastening base to the board. Shave more insulation from the wires if necessary, and turn the bared ends under the heads of binding screws. Remember that they must be turned in the right direction. Cut off all surplus wire before driving the binding screws down.

The last thing done on a bell job is "hooking up" the battery. Connect the wires to the dry battery binding posts. Press the push button to see if the bell rings properly. If not, apply the tests in Lesson IV and remove the "trouble."

Continue the study of the flow of electricity in W. H. Timbie's Essentials of Electricity by turning to page 6, and beginning with paragraph 5. Merely note the symbols and become familiar with the polarity of the electric current. Read on through paragraph 6, and try some of the examples and problems.

Time.—A man should complete this job in one hour.

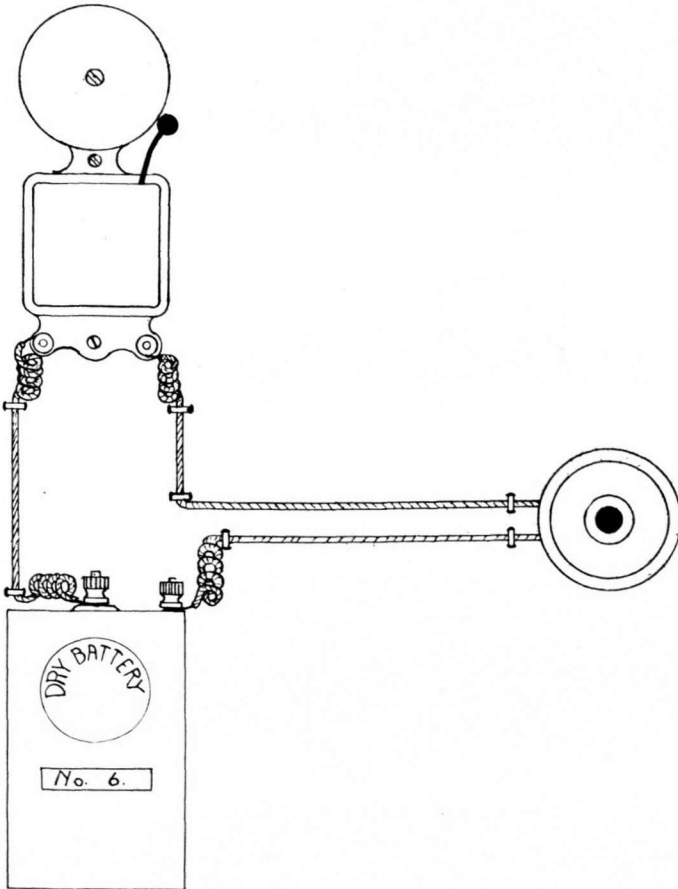


FIG. 4

Installation.—A front entrance electric call bell equipment for a private residence

Lesson VI

Job 1.—Locate outlets for the electric bell, push button, and battery.

Tools and equipment required.—One soft lead pencil, a zigzag rule, 5 feet long, and a spreading step ladder 5 feet high.

How to do the work.—First consult the diagram shown in Figure 4. Decide to locate bell outlet in entrance hall, kitchen, pantry, or in a servant's room. Place outlet near enough so that the bell may be heard by hall attendant or occupant of the room. Fix the location by marking with lead pencil. If the hall or room has picture molding, mark for outlet beneath

and close to picture molding. If without picture molding, fix location on the door trim of an entrance or built-in clothes locker. Place it between $6\frac{1}{2}$ feet to 9 feet from the finished floor. Avoid locations that may be covered by framed pictures, movable furniture, fixtures, or curtains.

Locate the push button outlet by placing a mark 4 feet above the outside entrance landing, on the door knob side of the mullion or jamb of door casing or on a brick or stone pier. Since boring through wood is easier than drilling through brick or stone, avoid placing outlet on a pier unless specifically demanded.

Locate the battery outlet on a shelf in a cool dry place in basement or in a clothes locker near bell outlet.

Before setting out to do the next job be sure to examine the walls between all outlets for picture molding, door, and window trim, base board, and wainscot to which your wires may be fastened with staples. Also observe the finish of the trim, the color of wall paper, or decoration so that you may select wire with insulation of a color to match. Avoid color contrasts that will tend to attract attention to the wires.

Questions for further study.—

1. What is an outlet?
2. Why should a bell outlet be set from $6\frac{1}{2}$ to 9 feet from the finished floor?
3. Why is it necessary to avoid locations that may be covered by framed pictures, movable furniture, fixtures, or curtains?

Time.—A man may do this job in 30 minutes.

Lesson VII

Job 2.—Install the wires according to the exposed work method.

The method of installing wires in a building depends upon the type of structure and the condition it may be in when the electrical equipment is contemplated. A general idea as to wiring methods can be obtained from Terrell Croft's *Wiring of Finished Buildings*. Although the book describes electric light wiring, the methods and tools are the same as for bell wiring. Paragraphs 113-114, on page 101, should be read.

Tools and equipment required.—One soft lead pencil, one 5-foot zigzag rule, one 5-foot spreading step ladder, one pair of 7-inch side cutting pliers, one $2\frac{1}{2}$ -inch Champion screw driver, one No. 13 bell-faced nail hammer, one ratchet brace, one $\frac{13}{32}$ -inch bell hanger's bit 18 inches long, ----- feet No. 18 annunciator wire in the following colors:

2 ounces $\frac{3}{8}$ -inch flat-head staples, one roll friction tape.

How to do the work.—Measure for the amount of wire needed to make the runs from outlet to outlet. Decide upon what colors you require and the amount of each. Fill in the amounts and colors in blank spaces above. Study the conditions on this job and find out what other tools you will need. Use blank spaces above to secure these extra tools.

With brace and bit bore through mullion or jamb of door casing. Direct the bit from the outside where the push button will set so that the end will come through on inside where the wire is least likely to be noticed. Proceed to other points along the route laid out for the wires. Where it is necessary to run wires through a partition into a room, bore holes through partition at some point over the door trim or at the junction of base board and door trim.

Next lay out your wires loosely from outlet to outlet and leave a surplus at each outlet. Then starting somewhere in the middle of the job and working toward each end in turn, begin fastening the wires with staples to the wood supports. Care should be taken to drive the staples over the wires just sufficiently to hold them in place and not to injure the conductor or its insulation. Drive them straight down over the wire and avoid spreading or driving them sideways. Two wires should not be fastened beneath one staple as it is likely to cause short circuits. Each wire must be fastened separately by staples staggered so they will not come in contact. Staples cutting through insulation and in contact also cause short circuits. The wire must be made to fit into the mold of trim in a neat manner.

If you find it necessary to lengthen a wire, "skin" about 1 inch of insulation off the ends of the wires to be joined. Scrape the copper wire clean, cross the ends, and turn them over each other so that the result will look like the drawing of the joint shown in fig. 5. All joints or splices must be insulated with friction tape. Tear off from roll about 4 inches of tape, strip into halves down its length. Beginning at insulation of wire on one side of joint, turn the tape spirally under tension toward the other side and make turns overlap until the bare wire is well covered. The insulation of a joint prevents contact of conductor with surface wired over, contact with adjacent wires, and furnishes protection against corrosion.

Continue fastening the wires in place until you have them all up. If you are unable to proceed with the next job, return to stock the tools and any material you may have.

Time.—One man may do this job in three hours. Two men working together may accomplish it in two hours. On some parts of the job they may work together; on other parts independently.

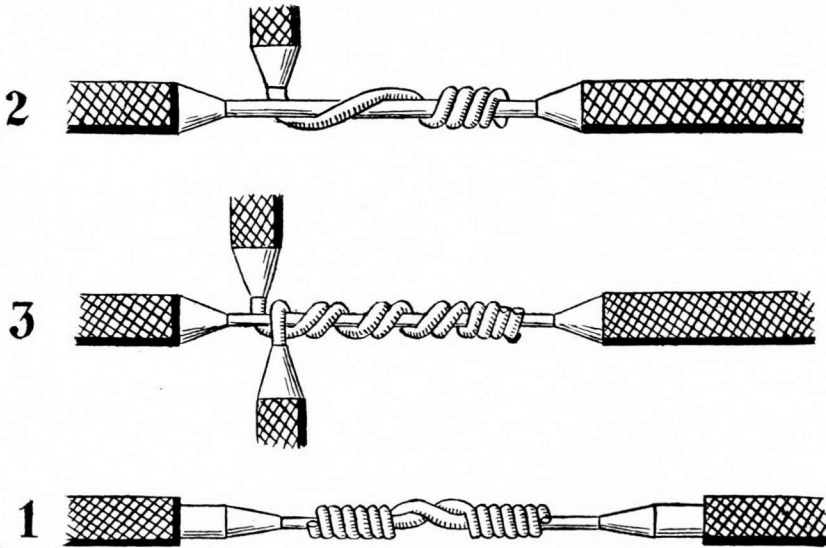


FIG. 5

Questions for further study.—

1. Is it good practice to place two wires under one staple?
2. Why do you insulate a running joint or splice?
3. What kind and size of wire have you used on this job?

Lesson VIII

Job 3.—Installing instrument, device, and battery.

Before starting to work toward completing this installation, continue the study of another factor in the flow of electricity. W. H. Timbie's *Essentials of Electricity*, paragraphs 7 to 9, pages 11 to 15, describe the pressure back of the current in electricity. Try some of the examples and problems. After you have become familiar with these, obtain tools and equipment and go to work.

Tools and equipment.—One 5-foot spreading stepladder, one 2½-inch Champion screw driver, one midget (Valley Pet) screw driver, one 13-ounce bell-faced nail hammer, one pair 7-inch side cutting pliers, one single blade jackknife, one soft lead pencil.

How to do the work.—By this time you know if your walls and partitions are made up of wood lath and plaster, metal lath and plaster, solid brick, or hollow tile and plaster. Read on through and order the screws, lead sleeves, toggle bolts, and wood blocks you will need in addition to the tools and equipment above described.

If of wood and plaster, at bell outlet set base of bell against wall, mark screw holes, puncture plaster at marks with a thin wire nail or brad awl until lath is reached for holding wood screws. Fasten the bell firmly to the wall with $1\frac{1}{2}$ -inch No. 5 round-head blued screws. If the wall is of solid brick or hollow tile and plaster, mark screw holes and with $\frac{5}{16}$ -inch star drill and hammer, drill holes into brick plug holes with wood plugs, or lead sleeves $\frac{5}{16}$ inch in diameter. If the star drill punctures the hollow portion of the tile insert toggle bolts. Next provide a wood block large enough for the bell and fasten the block to wall with $1\frac{1}{2}$ -inch No. 5 flat-head bright wood screws or the toggle bolts. If the wall is of metal lath and plaster, follow the method last described. Toggle bolts and wood blocks must be used for mounting bells on metal lath and plaster walls. Fasten the bell to the block with $\frac{3}{4}$ -inch No. 5 round-head blued wood screws. Be careful that the base of the bell does not touch the screws or toggle bolts used to mount the wood block.

Skin the insulation from ends of wire, form a helix of the wire and fasten the ends under the knurled nuts of the binding posts of the bell. Do not overlook the need for turning the wires in the proper direction when fastening to binding posts.

When setting a push button at outside entrance use a loose back metal push button. If the wires emerge from an outlet on wood jamb of door casing or mullion, set the plate against the surface and mark screw holes. Do any woodcutting required to make the plate fit snugly on the surface. Avoid having too much wire at this outlet. Skin the insulation from ends of wire, draw the ends through holes in base of push button, and fasten them under the head of binding screws—always in the proper direction. If a surplus of wire remains press it back into the outlet. Use $\frac{3}{4}$ -inch No. 5 round-head blued or brass wood screw for fastening plate to surface. The finish of screws depends upon the finish of the push button plate.

When setting a push button on a stone pier, use the same kind of push button. Mark for the screw holes and with $\frac{5}{16}$ -inch star drill and hammer drill holes into pier, plug holes with lead sleeves or wood plugs, connect wires and fasten plate in same manner as described for setting push button on wood jamb of door casing or mullion.

If the push button is to be set anywhere inside of the building a wood push button may be used. Care should be taken that the push button be located on the door knob side of the entrance.

Install the battery cells. If wet cells are provided, set them in a box large enough to hold; if dry cells are used bind them together with insulated wire, twine, or insulating tape. Set them on the shelf. Skin the insulation from ends of wires emerging from the outlet, form a helix of insulated portion, fasten the bared end of each wire to a binding post of the cell if one cell only is provided. If two or more cells of battery are used, connect them in series with pieces of insulated wire 12 inches long, bared at both ends; form insulated portion into a helix, fasten one bared end to carbon (+) binding post of one cell, the other bared end fasten to the zinc (−) binding post of adjacent cell. To the unconnected binding post attach the wires emerging at outlet.

Questions for further study.—

1. What kind of battery did you use on this job?
2. Name the positive and negative terminals of the battery used on this job.
3. Is it good practice to use a wood push button at outside entrance?

Time.—A man should require one hour on this job.

Lesson IX

Job 4.—Testing the wiring.

The equipment you have just installed may work just as you expected it would. Whether it does or does not, proceed to test it.

Before doing so, take up for study the remaining factor in the flow of electricity. W. H. Timbie's *Essentials of Electricity*, paragraphs 10 to 12, pages 15 to 18, describe the resistance offered to the flow of the electric current. Try some of the examples and problems. When you have become familiar with this factor, proceed to test your wiring.

Tools and equipment.—One 5-foot spreading stepladder, one 2½-inch Champion screw driver, one pair 7-inch side cutting pliers, one single blade jackknife, one lead pencil, two cells of dry battery, one vibrating bell and a quantity of wire sufficient to reach between the outlets farthest apart; that is, 2 feet.

How to test the wiring.—First measure the distance between the outlets farthest apart and find out how much wire is needed for the testing. Fill in space above. Place the dry cells in a handy box with bell fastened to the outside. Connect a wire between one binding post of the bell and one binding post of the battery set. Connect the cells in series. The wiring may be tested for continuous circuit at any one of the three outlets. Disconnect the wires from binding posts of battery and bell, and binding screws of push button. Join together the bared ends of wires at bell outlet. Do the same at the battery outlet. At the push button outlet connect the end of one wire to unconnected binding post of testing battery, and the end of other wire to unconnected binding post of testing bell. If connected in this way, the bell should ring. Separate the wires at bell or battery outlet and the bell should stop ringing. Should the bell fail to ring, there is a defect in the wiring. If this is the case, test each wire separately. Use for testing the wire you measured for at the outset. Skin each end. Fasten one end to one wire emerging at bell outlet, the other end to unconnected battery binding post of testing outfit. With a short wire fastened to unconnected bell binding post of testing outfit, touch the ends of each wire emerging at battery outlet. If the test bell fails to ring go to bell outlet, remove end of long test wire from the emerging wire to which it is attached and touch it to remaining emerging wire. The bell rings. Tag this wire with a piece of paper upon which mark "bell battery wire." Repeat at battery outlet. Test the button battery wire and section wire in the same manner tagging as you complete the test of each wire. Should any of the wires have "trouble" on them, trace the wire over its entire course, find and repair it. If two men work together in testing, time may be saved. Each should be stationed at an outlet from which the wire being tested emerges.

Questions for further study.—

1. What is a short circuit?
2. Describe an open circuit in wiring.
3. Which way should the ends of wires be turned when fastening to binding posts or under binding screws?

Time.—One man will require one hour to do this work. Two men may do it in 30 minutes.

Installation II.—Installing a front entrance electric call-bell equipment in a two-family wooden frame house

Lesson X

Job 1.—Locating the outlets.

A finished building is to be wired with all wires concealed except where they emerge at outlets. The wires are to be concealed without conduit.

The competent electrical worker must have a knowledge of the construction of buildings. Terrell Croft, *Wiring of Finished Buildings*, paragraphs 197 to 199a, inclusive, pages 150 to 153, gives a very good description of wooden frame buildings. Paragraphs 204 to 207a, pages 157 to 159, describe how the work in finished buildings may be done neatly. Study these paragraphs and when finished proceed to lay out your work.

Tools and equipment.—One 5-foot spreading step ladder, one ¼½-inch electrician's bit 18 inches long, one ratchet brace, one 13-ounce bell-faced nail hammer, one pair of 7-inch side-cutting pliers, one soft lead pencil, one 2½-inch Champion screw driver, one ⅜-inch auger bit, one 5-foot zigzag rule.

How to do the work.—First consult the diagram shown in Figure 6. Decide to place the outlets for the bells in the kitchen of each apartment. Begin in the upper apartment. Locate the outlet on an outside wall. Measure anywhere from 6½ feet to 9 feet from the floor and mark for outlet with pencil. With hammer tap lightly on the wall. If the sound of tapping on wall is hollow, your mark is between studs; if the sound is dull, your mark is over a stud. Continue tapping from side to side of mark until the hollow sound is produced. With brace and electrician's bit bore a hole through lath and plaster between studs. Repeat this work in kitchen of lower apartment.

Locate the outlets for push buttons outside of the front entrance, four feet above the landing on the door-knob side of the jamb of door casing. The door casing is generally hollow. Place push button plates against jamb, one over the other, and mark for holes to be bored. Bore holes through jamb with brace and $\frac{1}{8}$ -inch auger bit until hollow of casing is reached.

Locate the outlet for the battery in the basement on a shelf in a cool, dry place. Be sure to place the shelf farthest from heating apparatus.

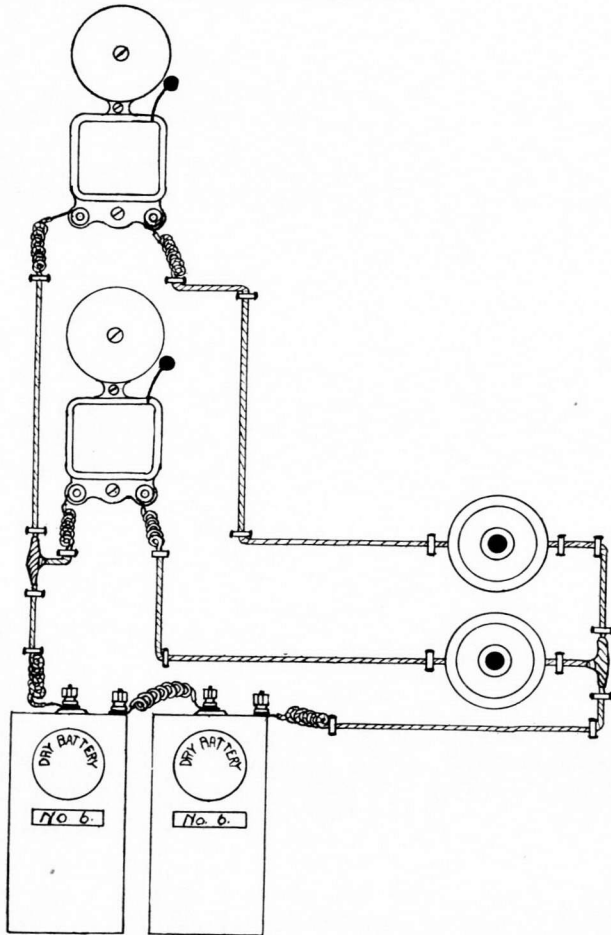


FIG. 6.

Questions for further study.—

1. What are continuous wall studs?
 2. Describe a joist.
 3. Describe wall and partition studs.
 4. To what kind of lath on these walls is the plaster applied?
- Time.*—One man alone should complete this job in one hour.

Lesson XI

Job 2.—Providing unobstructed runways between outlets and fishing wires.

Illustrated descriptions of how this work may be done will be found in Terrell Croft's *Wiring of Finished Buildings*. Paragraphs 208 to 218, pages 159 to 168, describe the removal of floor boards and cutting of pockets; paragraphs 219 to 226, pages 168 to 170, describe the removal and replacement of trim and baseboards and cutting into plastered surfaces. Study these paragraphs.

Tools and equipment.—One 5-foot spreading step ladder, one pair of 7-inch side-cutting pliers, one 14-ounce bell-faced nail hammer, one 2½-inch Champion screw driver, one 5-foot zigzag rule, one ¼-inch auger bit, one ratchet brace, one ½-inch electrician's bit 18 inches long, one 12-inch compass saw, one 1-inch woodcutting chisel, one single-blade jackknife, one soft lead pencil, one 50-foot ⅝-inch steel (snake) fishing wire, one roll ¾-inch friction tape, ——— feet No. 18 B. & S. gauge damp-proof office wire. -----

How to do the work.—As you proceed with the work on this job, you may meet with obstacles that will require tools the handling of which is not described in this lesson sheet. Terrell Croft's *Wiring of Finished Buildings*, paragraphs 227 to 295, pages 170 to 216, will tell you what tools to get and how they should be handled. Should you need them, list them in blank spaces above. Figure out approximately how much wire you will need. Fill in the amount in space above.

With a match or lighted candle heat the end of snake or fishing wire until dark red in color. With pliers turn end over to form a closed hook. Allow it to cool. Insert this end into the hole bored in plaster at bell outlet of upper apartment. Work the snake downward and feed in more snake as you work. When you have fed in enough snake to reach the floor of the room and the end strikes an obstacle, give it a few twisting turns and try to feed in some more. If the snake feeds in all right, find out whether the end is going down through wall of lower apartment to the cellar. If it feeds through to the cellar the end must come out at some place right below feeding point. Find it and pull out enough to fasten somewhere near by.

Go back to the outlet. Straighten out the snake to get at its other end. Form a closed hook on this end in the same way as you did the other. Measure the distance from the outlet to the cellar, double this and allow about four feet more. Now cut your wire. Fold wire into two lengths forming a loop. Skin about two inches of insulation from wire at loop. Fit the bared loop into the closed hook of the snake and fasten it firmly. Have some one in the cellar pull the snake downward while you feed the snake and wire until the hook with wire attached is pulled out into the cellar. Allow about 12 inches surplus at outlet and fasten it around a nail. Go to the cellar and unloosen the wire from the hook of the snake.

Repeat this operation and install two wires from bell outlet in lower apartment to the cellar. Leave loop in each wire.

Next go to the push-button outlets. Feed hook end of snake into upper push-button outlet and downward to the cellar. If an obstacle stops it, give it a few twisting turns until it comes out. Draw the snake down through to cellar until only a few feet remain at the outlet. Measure off three lengths of wire more than long enough to reach cellar. Skin the insulation from one end of each, twist them together and fasten them into the hook of the snake. Get a helper to pull snake with wires down into the cellar while you feed it in at the outlet.

At the push-button outlets choose one of the three wires for the button battery wire. Push the end of this wire back into the hole downward and out through hole beneath to feed lower push button. Choose another of the three wires for the section wire to lower push button. With hook on the end of snake pull it out through lower hole. You now have a surplus of button battery wire and section wire for each push button. Fasten these wires so that they will not pull down and become lost in the door casing.

Now go to the cellar and pick up all ends. First go to the loops of wire dropped from the bell outlets. Turn a small strip of friction tape around one of the wires in each loop. Cut the loops. You now have four ends. Skin two inches of insulation from the ends. Twist the ends of taped wires together. These are the bell battery wires. The remaining single wires are the section wires to each bell. Skin insulation from and join a wire to the end of bell battery wires, tape the joint well, and run the wire to the battery outlet. Skin insulation from and join a wire to each of the section wires; tape the joints well, and run both toward the section wires dropped down from the push-button outlets. Trace each sec-

tion wire by pulling it slightly at its push button outlet. Skin the insulation from all ends ready for joining. Do not join the section wires now. Skin the insulation from another length and join it to the button battery wire, tape it well, and run it to the battery outlet.

All of these wires should be fastened to the cellar ceiling. Take them the shortest course between points. Tape them all together every five feet with friction tape and fasten them to the ceiling with straps or staples.

At this stage of the work you should have two wires running from the battery outlet to the point where the wires drop from the bell outlets. Three wires should be running from this point to the point at front where the wires drop from the push button outlets. Here the section wires are skinned but not joined. Leave them in this condition.

Questions for further study—

1. Describe the bell-battery wire.
2. Roughly trace the circuit of this job.
3. Where is it best to install the battery?
4. What is meant by the term "fishing"?
5. What is a "snake"?

Time.—One man should require three hours to do this job. Two men should complete it in two hours.

Lesson XII

Job 3.—Installing instruments, devices, and battery, testing and connecting wiring.

The practical electrician employs several methods of testing low-voltage circuits. Terrell Croft's *American Electricians' Handbook* describes these methods in paragraphs 91 to 96, pages 38 to 40. Learn to know these methods and, if possible, use them on your jobs.

Tools and equipment.—Two vibrating bells, two wrought bronze loose back push button plates, two cells of dry battery, one 5-foot spreading step ladder, one brad awl, one soft lead pencil, one 13-ounce bell faced nail hammer, one pair of 7-inch side cutting pliers, one 2½-inch Champion screw driver, one midget (Valley Pet) screw driver, one single-blade jack-knife, one 5-foot zigzag rule, one roll ¾-inch friction tape, four 1½-inch No. 5 round-head blued wood screws, four ¾-inch No. 5 round-head blued or brass wood screws.

How to do the work.—The electric bells must be fastened firmly to the wall with round-head blued wood screws. To do this first set the base of the bell against the surface of the wall. With lead pencil mark for screw holes. Puncture plaster at marks with a thin wire nail or brad awl until laths are reached for fastening holding screws. Use screws long enough to hold bell firmly. Next skin the insulation from ends of wires emerging from the outlet, remove all kinks and twists, form a helix out of the insulated part of each wire and fasten bared ends under the knurled nuts of binding posts. Be sure to turn wires around under the nut in the direction that the nut turns to fasten wire.

A helix of insulated wire is formed at bell and battery outlets to take up and give a neat appearance to the surplus wire which may be needed for changing location or renewing connections of bell. To make a helix wind the insulated wire under tension around a pencil and remove the pencil.

The push buttons should be fastened to the jamb of door casing with round-head blued or brass screws depending upon the finish of the plates. Leave just enough surplus so that when the ends of wires at outlets are skinned there will be no difficulty in connecting. Remove kinks and twists. Skin off 1 inch of insulation from ends of wires, draw the ends through holes in base of push buttons and fasten under the heads of binding screws. Care should be taken that the wires are scraped clean, otherwise the connection will be so poor that it will be difficult for the current to flow. Be sure the wires are turned in the right direction beneath heads of binding screws. The surplus wires may then be pressed back into outlet and the push-button plate fastened. If the outlet holes are properly bored, the plates will line up without space between them.

The surplus wires emerging at battery outlet in the cellar should be free from kinks and twists. Skin the insulation at least 1 inch from the ends. Form a helix out of the insulated part of the wire. Fasten the bared end of one wire to the carbon binding post or positive (+) terminal of the battery. The bared end of the other wire fasten to the zinc binding post or negative (−) terminal of the battery. If two or more cells of battery are installed connect

them in series with a piece of insulated wire 12 inches long bared at both ends. Form insulated portions into a helix. Fasten one bared end of this wire to the carbon binding post of one cell, the other bared end fasten to the zinc binding post of the adjacent cell. Remember that wires turned around binding posts must be turned in the direction that knurled nuts turn to tighten. If turned in the opposite direction, there is a tendency to loosen and create a poor connection.

Now the bells, push button, and battery are connected ready for service. Go to the cellar where the section wires from the push buttons and bells are unconnected. With a few turns twist the bared ends of each section wire dropping down from a push button to a bared end of each section wire running from a bell so as to make temporary joints. The battery being connected, pressure upon lower push button outside of entrance should ring the bell in lower apartment; pressure upon upper push button should ring bell in upper apartment. If the result is opposite, go down to the cellar and disconnect joints. Reverse the wires and again make temporary joints. If the bells now ring as required when the push buttons are pressed, change the temporary joints into permanent ones, tape them well, and make final fastenings of all wires.

If the bells fail to operate, refer back to job 4 of installation one, and follow the instructions provided for testing, using the set of battery and a bell from your present equipment.

Questions for further study—

1. Would it be good practice to set the push button on the hinge side of door casing? Give a reason for your answer.

2. Explain why the bells are mounted so high above the floor.

3. Why is the bell located in the kitchen?

Time.—One man should do this work in two hours. Two men may do it in one hour.

Rehabilitation monograph. Joint Series No. 33.

Unit Course—Practical Civics I

PRACTICAL CIVICS

February, 1919—Trial edition

PART I. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENTS

This course is prepared for those men, both native and foreign born, who have had a limited elementary school education and who have no adequate knowledge or appreciation of the nature and functions of the important branches of our Government.

2. AIMS OF COURSE FOR STUDENT

The content of this course has been selected and arranged to fulfill the following aims:

(1) To stimulate a feeling of civic consciousness and patriotism through the knowledge of the fundamental facts of our Government.

(2) To sketch in informational form the most important features of our Government which do concern the lives of the average workman.

(3) To select only those facts and phases of our Government which will really interest this type of man.

(4) To present these facts in such form as will allow for an informal presentation of the topic by the instructor and will challenge the interest and questions of the students.

3. TIME REQUIREMENTS

This course is divided into 24 assignments which are grouped as follows:

(1) National Government—6 assignments.

(2) State Government—9 assignments.

(3) Local Government—9 assignments.

Each assignment will require approximately 40 minutes, and is presented in this form:

- (1) General heading.
- (2) Special topics to be developed by the instructor.
- (3) Problem to be presented to the class for discussion.

4. EQUIPMENT

- (1) Notebooks.
- (2) Blackboard.
- (3) Textbooks.

Plass—"Civics." D. C. Heath.

Shimmell—"The Government of the United States." Chas. Merrill Co.

Forman—"Essentials in Civil Government." American Book Co.

Nida—"City, State, Nation." The Macmillan Co.

Dunn—"Community and Citizen." D. C. Heath.

Turkington—"My Country." Ginn & Co.

Hill and Davis—"Civics for New Americans." Houghton-Mifflin Co.

Ashley—"The New Civics." Macmillan Co.

NOTE.—The textbooks are used for directed supplementary reading. These books should be read carefully by the instructor not only for his own inspiration and possible information but also for the purpose of making recommendations to the individual student of the books which are best adapted to his particular ability and interests.

5. SUGGESTIONS TO TEACHERS

This course is prepared for use in group instruction. It appeals to those men of foreign birth who have been naturalized since they have joined the Army and to native-born men who have a very slight and indefinite knowledge of our democracy and the important powers of a voter. The course is intended for use under a conference or forum plan of instruction. The conference idea will be worked out to best advantage when a group of ten or more men attend. Each conference is opened with a talk by the instructor, in which he presents the general topic for discussion and develops those facts and experiences common to the students as type illustrations of the nature and functions of the office or department under consideration.

The success of the course depends on the character of the instructor's presentation of the topic. His talk must be simple in character, replete with timely illustrations, references, pictures, anecdotes, etc. The suggestive list of topics for illustrations is by no means inclusive. In many instances, time limitations will not permit the completion of all the topics suggested. The instructor must vary his address and avoid the strict lecture form of presentation. The interest of the students can be aroused and sustained by occasional questions and by challenging the reactions of the students in personal experiences illustrating the topic under consideration.

The instructor should attempt to have each student in the group contribute to some part of the discussion of the problem. Very frequently the student will have an opportunity to mention some facts which he has learned from the directed reading assigned for out-of-class work.

No formal reading lesson is included in the conference work of an assignment. The instructor should prepare a list of reading references for each of the topics in each of the books recommended. The student must be encouraged to do this reading faithfully each day and to bring back to class for discussion and explanation any difficulties which he meets in the text.

6. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit course issued by the Committee on Courses of Study for Disabled Soldiers, under the direction of the Surgeon

General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

7. STANDARDS

At the end of this course, a student should be able to answer the following questions in oral or written form:

- (1) Explain the procedure involved in making prohibition an amendment to the Constitution.
- (2) What are the advantages of State control and legislation on accident prevention in industries?
- (3) How is the tax levy of a city or town apportioned?

PART II. STUDENTS' INSTRUCTION SHEETS

[These Students' Instruction Sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the Students' Instruction Sheets have not been printed separately as was originally intended but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.]

ASSIGNMENT I.—NATIONAL GOVERNMENT

General topic:

President Wilson.

Suggestive topics for instructor:

- a. Chief Executive of the United States.
- b. Residence in White House in Washington, D. C.
- c. When elected and reelected.
- d. Elected by the people of the whole United States—according to the constitution of our democracy.
- e. Contrast the election of President Wilson with the accession of George V of England.
- f. Contrast President Wilson's powers and responsibilities to the people with those of the German Kaiser.
- g. Three predecessors to President Wilson—Taft, Roosevelt, McKinley.

Problem:

Name three of the most important acts of President Wilson during the past year.

ASSIGNMENT II.—NATIONAL GOVERNMENT

General topic:

Congress.

Suggestive topics for instructor:

- a. Lawmakers for the whole United States.
- b. Most important duties other than lawmaking those of levying taxes, declaring war, and approving the treaties of peace.
- c. National Capitol in Washington, D. C.
- d. Citizens elect the Members of both the Senate and the House of Representatives. (Contrast with House of Lords.)
- e. Name the Senators from the different home States of the various members of the group.

Problem:

Discuss the draft law—its necessity, fairness, and importance.

ASSIGNMENT III.—NATIONAL GOVERNMENT

General topic:

Constitution of the United States.

Suggestive topics for instructor:

a. Code of laws for the citizens of every State.

b. National prohibition (type legislation).

(1) Bill proposed and accepted by National Congress in 1917.

(2) As a proposed amendment it is now referred to voters of each State for adoption.

(3) Bill must be accepted by 37 States before it can become an amendment to the Constitution.

c. Thirteenth amendment—Lincoln.

d. Declaration of Independence.

e. Adoption of the Constitution (laws for the people made by the people).

f. Some important facts about Washington, Jefferson, Hancock.

Problem:

Show how the people of the United States really control the adoption of any change or addition to the Constitution.

ASSIGNMENT IV.—NATIONAL GOVERNMENT

General topic:

Post office.

Suggestive topics for instructor:

a. Federal control of postmen and post-office buildings.

b. Stamps and mail protected by the United States Government.

c. Tampering with the mails an offense punishable by imprisonment in a Federal prison.

d. Postal employees paid by the United States Government.

Problem:

What advantage do we have from a Federal post office?

ASSIGNMENT V.—NATIONAL GOVERNMENT

General topic:

Immigration.

Suggestive topics for instructor:

a. Permission to enter this country given by United States inspectors representing Government of whole country.

b. Literacy test—advise friends now who might be planning on coming in when war is over.

c. Customs—Inspectors.

(1) General duties.

(2) Description of inspection at Ellis Island, Boston, New Orleans.

Problem:

What did you expect to get in the United States which you could not get in the old country?

ASSIGNMENT VI.—NATIONAL GOVERNMENT

General topic:

Army and Navy.

Suggestive topics for instructor:

a. President Wilson, Commander in Chief of the Army and Navy of the United States.

b. Secretary Baker (Secretary of War), in charge of the camps.

c. Secretary Daniels (Secretary of the Navy), in charge of the Navy.

d. The draft law, why necessary; important results.

e. War declared by President and Congress.

f. Peace terms. Peace treaty O. K'd by Senate.

Problem:

What are the three most important propositions in President Wilson's peace terms?

ASSIGNMENT VII.—STATE GOVERNMENT

General topic:

Governor of a State.

Suggestive topics for instructor:

- a. Manager of State. Elected by people for term of generally one or two years.
- b. Offices in statehouse or capitol. (Name the capital of the home State of each student.)
- c. Necessity of careful consideration by every voter to select the best man.
- d. Power in appointing heads of many departments and members of special commissions.

Problem:

Discuss the veto power of the governor.

ASSIGNMENT VIII.—STATE GOVERNMENT

General topic:

State legislature.

Suggestive topics for instructor:

- a. Members elected by citizens of each State.
- b. Sessions held in State capitol.
- c. Laws for each State in State constitution.
- d. Referendum—purpose; worth; examples.

Problem:

Discuss two or three important acts of legislation passed by several State legislatures in recent years; e. g., compulsory school education up to age of 14 years; workmen's compensation act.

ASSIGNMENT IX.—STATE GOVERNMENT

General topic:

State board of education.

Suggestive topics for instructor:

- a. Compulsory school attendance.
 - (1) School year.
 - (2) Age limits.
- b. State aid for trade schools (day and evening).
- c. State colleges—free to residents in State.
- d. School supervision. Standards in work offered.

Problems:

Discuss the opportunities for trade education in some State-aided school (printing, plumbing, machine shops, etc.).

ASSIGNMENT X.—STATE GOVERNMENT

General topic:

State taxes.

Suggestive topics for instructor:

- a. Why is money needed? (Roads, bridges, parks, schools, institutions, etc.)
- b. Necessity for State taxes (opportunities used by citizens in different towns and cities).
- c. Kinds of taxes:
 - Income tax.
 - Excise tax.
 - Personal tax.
 - Property tax.
 - Poll tax.

Problem:

Show how towns and cities should pay taxes in the matter of State health laws.

ASSIGNMENT XI.—STATE GOVERNMENT

General topic:

State roads, parks, and forests.

Suggestive topics for instruction:

- a. Name several State roads near local communities of each student.
Compare excellent condition, appearance, etc., with ordinary streets.
Show advantages for automobiles, trucks, heavy wagons, market routes, etc.
- b. Describe some metropolitan park system, beach front, river front.
Show advantages to communities in healthful recreational opportunities.
- c. Sketch briefly importance of State forests—tracts as watersheds.

Problem:

Show how the voter may know whether or not his representatives support good roads and parks.

ASSIGNMENT XII.—STATE GOVERNMENT

General topic:

States civil service.

Suggestive topics for instructor:

- a. Show necessity and importance of having the best workers in every department of the State. Discuss good salaries available.
- b. Show advantages of competitive examinations.
- c. Show necessity of State control of examinations.
- d. Discuss types of examinations—clerical work, food inspectors, fire inspectors, etc.

Problem:

Why should the appointments to State positions be under State control and not left to individuals?

ASSIGNMENT XIII.—STATE GOVERNMENT

General topic:

State licenses.

Suggestive topics for instructor:

- a. Importance of having State control of motor vehicles:
 - (1) Protection against careless driving.
 - (2) Allows for driving in various towns, cities, and States.
 - (3) Ruling about registration in new States.
- b. Automobile registration (autos, trucks, motor cycles).
- c. State inspection of elevators.
- d. Boilers (engineers' licenses).

Problem:

Picture condition if factories were not required to meet State regulations regarding fire escapes and exits.

ASSIGNMENT XIV.—STATE GOVERNMENT

General topic:

State aids for labor.

Suggestive topics for instructor:

- a. Workmen's compensation.
 - (1) Requires employers to insure employees against accidents at work from any cause.
 - (2) Requires employers to pay doctors' bills and such amounts of money as the seriousness of the accident calls for; provides also for future support of men and women disabled.
- b. State board of labor.
 - (1) Employment agencies.
- c. State board of arbitration.
 - (1) Fair settlement of labor troubles.

Problem:

Discuss advantages of present methods of adjusting labor difficulties as conducted by Mr. Endicott, of Massachusetts.

ASSIGNMENT XV.—STATE GOVERNMENT

General topic:

State courts.

Suggestive topics for instructor:

- a. Justice to every citizen in cases of—
 - (1) Accidents caused by neglect of others.
 - (2) Violation of property rights.
 - (3) Settlement of wills and estates.
- b. Protection against violation of State laws regarding sale of impure foods; fire prevention; accident prevention; repeated criminal offenses.
- c. Courts for cases appealed from decisions of lower local courts.

Problem:

Discuss the details of an ordinary civil suit for nonpayment of a bill.

ASSIGNMENT XVI.—LOCAL GOVERNMENT

General topic:

What the local government does for the *home*.

Suggestive topics for the instructor:

- a. Police protection.
 - (1) Personal property (money, jewelry, clothes, etc.).
 - (2) Property protection (house, yard, cellar, etc.).
 - (3) Street protection (thieves, assault).
 - (4) Right attitude toward policemen.
- b. Fire protection.
 - (1) Prompt, efficient, dependable.
 - (2) Prevention of fires spreading to whole districts.
 - (3) Dangers which firemen face.
- c. Health department.
 - (1) Pure-food regulations.
 - (2) Clean stores.
 - (3) Clean houses.
 - (4) Disease isolation, fumigation, and prevention.
- d. School department.
 - (1) Free educational opportunities for all.

Problem:

Compare the above advantages with those of foreign countries.

ASSIGNMENT XVII.—LOCAL GOVERNMENT

General topic:

Police department.

Suggestive topics for instructor:

- a. Chief of police.
- b. Police stations.
- c. Duties of policemen—to help in keeping good order and to stop disturbance.
- d. Dangers of policemen.
- e. Police courts.
- f. Cost of public service.

Problem:

Consider conditions which would exist in local community if policemen were to be withdrawn for any length of time.

ASSIGNMENT XVIII.—LOCAL GOVERNMENT

General topic.

Fire department.

Suggestive topics for instructor:

- a. Modern fire apparatus; motor-driven powerful engines, etc.
- b. Old-time methods of fire fighting (volunteer companies, bucket brigades).
- c. How alarms are sounded.

Suggestive topics for instructor—Continued.

- d. What to do in case of fire.
- e. Respect for firemen.

Problem:

Discuss the important work which different members of the group have seen the firemen do.

ASSIGNMENT XIX.—LOCAL GOVERNMENT

General topic:

Street department.

Suggestive topics for instructor:

- a. Importance of good streets—transportation, health, appearance.
- b. Cost of good streets (general discussion about modern methods of road construction).
- c. What each citizen can do to help in the work of clean streets.
- d. Superintendent of streets.

Problem:

Discuss the real economies in good road construction for towns and cities.

ASSIGNMENT XX.—LOCAL GOVERNMENT

General topic:

City or town clerk.

Suggestive topics for instructor:

- a. Compulsory registration of birth records (purpose and use).
- b. Compulsory registration for marriage certificates.
- c. Records of city's business.
- d. Records of city ordinances.
- e. Notifications of meetings to citizens.

Problem:

Discuss city and town reports.

ASSIGNMENT XXI.—LOCAL GOVERNMENT

General topic:

School department.

Suggestive topics for instructor:

- a. The foundation stone of every democracy.
- b. Little red schoolhouse of colonial days.
- c. Compare small one-room country school with a large high school in New York City—200 rooms, 190 teachers, 6 stories, 4,500 pupils.
- d. School department elected by the citizens—responsible to government.
- e. Cost of schools larger than that of any other department; averages 30 to 40 per cent of total expenses.
- f. Compulsory school attendance law—powers of "attendance officer."

Problem:

Compare educational opportunities in America with those of Russia.

ASSIGNMENT XXII.—LOCAL GOVERNMENT

General topic:

City taxes.

Suggestive topics for instructor:

- a. Departments requiring largest amounts of revenue—
 - School.
 - Street.
 - Police.
 - Fire.
 - Sewer.
- b. Tax rate.
- c. Property valuation by assessors.
- d. Poll tax (State tax paid to city or town treasurer).
- e. Taxes paid by *everybody*—
 - (1) Property owners directly to city treasurer.
 - (2) Persons not owning property paid in rent and cost of living.

Problem:

Show how citizens by vote control the tax rate.

ASSIGNMENT XXIII.—LOCAL GOVERNMENT

General topic:

Water department—

Suggestive topics for instructor:

- a. Waterworks not always owned by local municipalities.
- b. Cost borne by citizens in tax rate.
- c. Water supplies—lakes, ponds, artesian wells, rivers (filtration).
- d. Water-supply equipment—
 - (1) Large supply mains.
 - (2) Pumping stations.
 - (3) Reservoirs.
 - (4) Meters.
- e. Water waste.

Problem:

Compare water convenience in modern house with those in old farm houses.

ASSIGNMENT XXIV.—LOCAL GOVERNMENT

General topic:

City and town government.

Suggestive topics for instructor:

- a. City government—
 - (1) Mayor—chief executive.
 - (2) City council—lawmakers elected by people for short terms and directly responsible to people.
- b. Town government—
 - (1) Chairman of board of selectmen.
 - (2) Selectmen—elected by people at town meeting.
- c. Town meeting—best type of democracy—direct vote of citizens on questions of local government.

Problem:

Discuss any war measures taken by city councils in recent months.

Rehabilitation monograph. Joint Series No. 34.

Unit Course—Physical Education 2—Instructor's Manual

PHYSICAL EDUCATION EXERCISES FOR ORTHOPEDIC CASES

February, 1919—Trial Edition

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EXERCISES FOR ORTHOPEDIC PATIENTS

1. FOR WHOM INTENDED

These exercises are intended for patients with defects or deformities, chiefly of bone and joint, most of these being the result of gun-shot or shrapnel wounds, accident and similar causes.

2. NEED FOR EXERCISE AND ADVANTAGE TO BE GAINED

General.—(a) The feeling of improved well-being, the result of general improvement in health and strength, circulation, respiration, digestion and elimination having been improved through general exercises, which should be given in connection with special exercises at each period.

(b) Increase in muscular strength.

(c) Greater self-confidence resulting from a realization of the ability to do some physical work with the injured part.

Special.—The patient's injury causes a weakness of the part with structural and functional change, possibly also a destruction of certain tissues. Treatment by the surgeon usually includes immobilizing the part in a cast or splint to allow regeneration of the injured or destroyed tissue. When this tissue has been restored sufficiently to allow movement of the part, exercise is found helpful to—

(a) Stimulate growth of the injured part.

(b) Increase range of motion and strength of the joint involved.

(c) Remove adhesions and increase strength of the nerve, muscle, joint mechanism.

3. SELECTION OF EXERCISES

General.—Whenever possible, include exercises of the trunk, which tend to improve digestion, assimilation and elimination. Exercises of the legs, as walking, running, jumping, to improve the circulation; breathing exercises to aerate the blood. The result is general improvement in physical health and strength.

Special.—Select exercises and give them, depending upon the patient's condition, mildly, moderately, or vigorously. Gradually increase the vigor and length of period.

Recreational.—(a) Hikes may be used to advantage for both physical exercise and for recreation. They should be of an informal nature, the only formality being the regular formation and regular cadence. Whistling of tunes and singing of songs add greatly to the spirit of the patient during these hikes.

(b) Games and events must be selected according to the patient's disability and general strength, also according to size of group, space available, and complexity.

4. THE EXERCISES

Ten to thirty minutes twice daily or twenty to sixty minutes once a day should be devoted to the exercises.

General.—Trunk exercises and those involving walking, running and jumping and breathing exercises should be included in each lesson. These are for general improvement.

Special.—The exercises are arranged according to the part disabled. Progression in an exercise may be had by first giving it with assistance (assistive), then in a free manner (active), then with resistance (resistive).

5. INSTRUCTIONS TO TEACHERS

General.—The instructor's attitude toward his patient should at all times be sympathetic and considerate. Only such discipline as is necessary to bring results should be demanded. A heart-to-heart talk emphasizing kindness, helpfulness, and appealing to the men on the basis of improved physical condition is helpful in establishing cooperation between instructor and patient. Allow the men to stop during an exercise if marked discomfort results. This will often pass after the first few days in each grade. Give exercises carefully at first, avoid-

ing snappy movements. Each exercise is to be given both left and right, and is to be taken a few times on command, then in rhythm. Movements are to be executed accurately and with full range—complete extension, flexion, etc. Exercising with the men stimulates them to more vigorous and accurate execution. There should be a rest period after each exercise.

Demonstration

Demonstrate each new exercise, then take it on command a few times, then in rhythm. Demonstrations should be counter-like. That is, if the men are to do an exercise to their left, show it to your right.

Command

Correct execution of an exercise depends largely upon the command. Every command is divided into two parts: The preparatory command—explains the movement (give it in a short, precise manner); the command of execution—the signal to begin. Character of the command as of the rhythm depends on the character of the movement—i. e., slow and vigorous, sharp and snappy. Pause—there is a pause between the two parts of the command. Breathing exercises are taken on command or in very slow rhythm—not more than three or four times in succession. Avoid holding the breath during any movement.

Rhythm of movements

Arm and leg movements—usually in fast rhythm; trunk and head movement—always in slow rhythm; jumping—usually in fast rhythm; balancing—not done in rhythm, but on count or command; breathing—always slow; compound exercise—the rhythm is that of the slow movement.

Ex.: Bend arms for thrust and raise chest. The movements of both arms and chest are slow in this exercise because chest raising is done slowly.

Exercises for general physical improvement

These should be used in connection with the special exercises, as a means of obtaining general physical improvement and include especially hopping, running or jumping, trunk exercises, and breathing exercise. The choice of these exercises depends on the condition of the patient. Hikes, especially if taken briskly, and games and athletic events, will be found valuable in this connection.

Special.—In the special exercises the progression is from assistive to active to resistive. Preparation of limb or joint by electricity, radiant heat, hot baths or massage is very helpful.

1. Assistance is used to diminish natural resistance.
2. Passive exercise is used where the movement can not be done otherwise.
3. Resistance is used when muscle is capable of performing a movement through its whole arc, so there may be no interruptions, and should be weak at the beginning, strong in the middle, weak at the end, never stopping the movement. Correct resistance will make one muscle group work alone and exclude its antagonists.
4. Muscles work better against resistance than free. Resistance may be given by hand, friction, brake, elastic cords, springs, raising graduated weights by lever, rope pulley.

Use a limited number of exercises in special work. Explain the purpose and change them from time to time.

6. PROGRESSION OF EXERCISES

(a) Progression is indicated in instructions to teachers under heading "Special." It may also be had by increasing the number of movements taken, or by increasing the resistance.

(b) In the hikes the progression is made upon the basis of increasing the length of period a minute or two daily, or increasing the cadence, or both.

(c) The progression in the games is upon the basis of length of period and vigor.

7. MODIFICATION OF EXERCISES FOR INDIVIDUAL NEEDS

(a) The patient is assigned to his grade by the medical officer, depending upon his physical condition.

(b) Where there is marked distress, the patient should be allowed to rest or at least take the exercise less vigorously.

(c) In some cases it is necessary to encourage the patient. In other cases, to restrain them.

(d) Although the exercises are given to groups, each patient must be considered as an individual case. Some will progress quite regularly, while others will show irregular progress.

8. TESTS TO APPLY IN DETERMINING VALUE

(a) To some degree the patient's feeling of well-being, as expressed by himself or shown in his actions, is a test, as is also his ability to take the exercise without unfavorable reactions, as extreme pain, though slight pain must be expected while the injured part is being exercised, especially at first.

(b) The important tests are those indicated through general improvement in muscle and joint strength. The range of movement can be measured by protractors or sheet-iron scales marked with degrees; while strength of part can be determined by use of dynamometer.

9. REFERENCES

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2. Treatment of Infantile Paralysis. Lovett. P. Blackiston Sons & Co., 1012 Walnut Street, Philadelphia.
3. Therapeutic Exercise and Massage. Bucholz. Lea & Febiger, Philadelphia.
4. Physical Remedies. Fox. Wm. Wood & Co., New York.
5. Games for the Playground, Home, School, and Gymnasium. Jessie Bancroft. Macmillan Co., New York City.

10. EXERCISES FOR ORTHOPEDIC CASES

(a) *Exercises for flat-foot*

Exercises for the adductors of the feet:

1. Feet parallel—rise on outer borders of feet, knees straight—1. Return—2.

2. As 1. Walk on outer borders.

Exercise for rotators of hips:

3. Feet parallel. Rotate legs outward (forward), using great toe as a pivot.

Exercise for intrinsic foot muscles and anterior arch:

4. Stand with toes projecting over edge of table or step, and flex, extend, abduct (spread) the toes.

5. Raise heels and walk on toes. Patient should rise as high as possible, toes pointed in; otherwise the exercise may be of no value and even be harmful.

6. Circling (circumduction) inward of foot. Patient seated; heels on floor as pivot. Move foot outward—1; downward and together—2; upwards—3. (During 2 and 3 cup (supinate) the feet.)

7. Flexion and extension of ankle—sitting.

8. Raise inner edge of foot—1; raise heels—2; return—3, 4.

9. Carry bath towel or other cloth article by grasping with toes.

10. For adductors: Place the forefoot on one end of a towel. The foot grasps the towel, pulling it inward. Put weights on the towel as resistance. Practice with and without weightbearing. Avoid leg rotation at the hip.

11. Passive. Sit on floor, legs crossed in front, pull up on arch with hands.

12. Raise arch by separating knees.

13. Raise heels—1; roll back on outer edge of feet—2.

14. Walk along two planks forming inverted V trough—one foot on each side.

15. Large strides, feet pointed in, footprints painted on floor.

(b) Shortened tendo Achillis

1. Walk with steps on normal length, feet turned in (adducted).
2. Stride stand, feet 24 inches apart (sideward or forward and backward). Alternate knee bending.

(c) Toes

1. Stand with toes projecting over edge of step; flex, extend, abduct the toes—develop intrinsic muscles of the foot and raise anterior arch.
2. Grasp towel with toes, as under flat foot.
3. Flexion. Patient sits or lies on back and bends toes toward sole of foot (makes a fist). Resistance is offered by placing finger across underneath toes and pushing up against them.
4. Extension. Patient sits or lies on back and bends toes toward dorsum of foot. Resistance is offered by finger placed on dorsal surface of toes.

(d) Ankle

Dorsal flexion or flexion of the ankle:

1. Raise toes from ground and balance on heels.
2. Do same sitting—resist on dorsum and steady leg.

Plantar flexion or extension of ankle.

1. Raise heels. Walk on tip toes.
2. Patient lies on face, feet over edge of table and straightens ankle (plantar flexion) against resistance.

Inversion of foot:

1. Patient lies on back, foot held above the ankle to steady it. Operator turns the foot inward toward the other ankle.
2. Patient sits with foot hanging free, lower leg held firmly, and turns foot inward and attempts to touch operator's finger, which is first held slightly above the great toe on the inner side of the foot, and then held slightly below the great toe joint.

3. Patient sits on table, legs hanging down and steady, and attempts to turn the front of the foot in and up toward the other ankle without or with resistance against the inner border of the foot.

Eversion of foot:

1. Patient lies on back and operator holds the affected leg. Operator turns the foot out and away from the other foot.
2. Patient sits with foot hanging free with knee steady and turns the foot outward. Games and events (see list at end of manual).

(e) Exercises for knee

Free exercises:

1. Bend knees $\frac{1}{2}$ deep (or deep)—1. Return—2.
2. Raise knee forward—1. Straighten leg forward—2. Return—3, 4.
3. Raise foot backward—1. Return—2.
4. Side stride and forward stride stand. Bend knees alternately.
5. Raise heels—1. Bend knees—2. Return—3, 4.
6. Lunge in various directions.
7. March in and from place, also run in and from place.
8. All foot and leg exercises may be used to advantage.

Special exercises:

Flexion of knee—

1. Patient lies on face and flexes knee until heel touches buttock (resistance may be applied at ankle).
2. Patient lies on back, affected leg held in vertical position. Resistance is offered in back of ankle as patient flexes knee.

Extension of knee—

1. Patient sits on heels, shifts weight on leg to be tested and comes to erect position on that leg, steadying self by holding operator's hand.

2. Patient sits on table, knees flexed and hanging over, and extends knee against resistance in front of ankle.

3. Patient lies on face, knee flexed and extends knee against resistance.

Apparatus:

1. Pulleys.

2. Climbing pole and ropes.

3. Stall bar, horizontal bar, etc.

4. Rowing machine.

5. Bicycle.

Games and events involving flexion and extension of knee—any running and active games.

(f) *Exercises for hip*

Free exercises:

1. Raise or swing leg forward, sideward, backward.

2. Lunge sideward, forward.

3. Balancing. Raise leg forward—1. Carry leg backward and lower trunk forward—2. Return—3, 4.

4. March or run in place or from place.

5. Jump to stride stand—1. Return—2. This exercise with hands on hips.

Special exercises:

Flexion—

1. Patient sits with lower leg hanging over edge of table and raises knee to chest without or with resistance in front of thigh just above knee.

2. Patient lies on back and raises knee to chest without and with resistance.

Extension—

1. Patient lies on face and hyperextends hip with knee straight, raising the leg from the table.

2. Patient lies face down, hips flexed over edge of table and raises legs to horizontal position.

3. Patient lies on back and raises affected leg (knees straight) as high as possible, and as patient brings leg back to table, instructor resists.

Abduction—

1. Patient lies on sound side and raises affected leg (knee straight).

2. Patient lies on back (pelvis held) and abducts leg.

Adduction—

1. Patient lies on back, legs in abduction. Adduct the leg.

2. Patient lies on back, knees and hips flexed, soles resting on table, knees apart and brings knees together without or with resistance.

Rotation:

1. Rotation inward. Patient sits with knees flexed and lower legs over edge, keeping knees together and moves affected foot away from other foot.

Patient stands or lies on back and rotates whole leg inward (rotate hip forward).

2. Rotation outward. Patient sits on edge, knees flexed and feet hanging over edge of table and moves foot of affected leg inward across other leg without or with resistance.

Apparatus:

1. Pulley machine.

2. Bicycle.

3. Stall and horizontal bars.

4. Horse.

5. Buck.

Games and events, especially those involving kicking.

(g) Marching, running, jumping

1. Run (or march) in place raising knees forward.
2. Run (or march) in place raising foot backward.
3. Run (or march) in place with extended knees. (Legs straight.)
4. Hop on left foot—1, 4. Hop on right foot—5, 8. Run in place—9, 16.
5. Hands on hips. Jump in place eight times—1, 8. Jump to stride stand and return four times—9, 16.
6. Jump to stride stand, arms sideward—1. Jump to cross stand (feet crossed) and cross arms front of chest—2.
7. Hands on hips. Bend knees—1. Jump to stride stand—2.

(h) Trunk

Forward and backward:

1. Swing arms foreupward—1. Bend trunk forward and touch toes—2. Return—3, 4.
2. Stride stand, arms bent for thrust. Bend trunk forward and thrust forward—1. Return—2. Lower head backward and thrust upward—3. Return—4.
3. Stride stand. Swing arms foreupward—1. Lower trunk forward and arms sideward—2. Return—3, 4.
4. Stride left sideward and bend arms for thrust—1. Lower trunk forward—2. Return—3, 4.
5. Stride stand arms sideward. Bend left knee, bend trunk forward and cross arms under left thigh—1. Return—2. Right—3, 4.

Sideward:

1. Feet closed, arms sideward. Turn trunk left—1. Return—2. Right—3, 4.
2. Stride stand, hands on hips. Bend trunk forward—1. Backward—2. Left—3. Right—4.
3. Hands on hips. Turn trunk left—1. Bend trunk forward—2. Return—3, 4.
4. Side stride stand, hands on hips. Bend trunk forward—1. Circle trunk left—2. Backward—3. Right—4. Forward—5. Straighten trunk—6.
5. Stride stand. Bend trunk left and raise right arm sideupward—1. Return—2. Right—3, 4.
6. Arms bent for thrust. Turn trunk left and thrust right arm forward—1. Return—3. Right—3, 4.

Head and neck turning and lowering in all directions, also circling, are valuable.

Games and events involving trunk bending and turning should be used.

(i) Chest and breathing exercises

For general improvement and for increasing flexibility and expansion of the chest and lungs:

1. Hands on hips. Raise chest and inhale—1. Return—2.
2. Raise arms foreupward and inhale—1. Lower arms sidedownward and exhale—2.
3. Bend arms for thrust and inhale—1. Return—2.
4. Raise arms sideward, palms up, and inhale—1. Return—2.
5. Hands on hips. Raise chest and inhale—1. Bend trunk forward and exhale—2.
6. Side stride stand. Raise right arm sideupward, bend trunk left sideward and inhale—1. Return—2. Same to opposite side—3, 4.

(j) Shoulders

Free arm movements:

1. Raise arms forward—sideward—foreupward—sideupward.
2. Straighten or thrust arms in all directions.
3. Boxing movements.
4. Combine trunk and arm movements.
5. Movements of throwing, batting, etc.

Special exercises:

1. Raise arms against resistance.

2. Patient sits with arm down, forearm flexed at right angle. Operator behind patient, grasps the wrist and forearm with one hand, the shoulder with the other. The forearm acts as a lever, the elbow as a fixed point. Move hand sideward—1. Return—2.

3. Patient seated, arm sideward. Operator behind, one foot on the bench, the knee under the axilla, one hand on the shoulder to steady the scapula, the other below the elbow. Rotate arm in circle, gradually increasing in size.

4. Patient with side to the stall bar, arm rigidly extended. Climb up bar by fingers, with straight arm (abduction).

Exercises for pulley weights:

1. Rotation. Patient grasps the floor handle, elbow on a bracket at shoulder height, forearm horizontal and flexed at right angles, and pulls up with the hand throughout the whole range of movement without changing the height of the elbow or its flexion.

2. Flexion and extension. Patient stands back to floor handle, arms down and straight, and raises the arms forward. Patient also faces floor handle and raises arms backward.

3. Abduction and adduction. Patient stands with side to the machine, grasping shoulder attachment, and moves the arm upward—1. Return—2. Downward—3. Return—4. Using overhead attachment, patient brings the arms sidedownward. Using floor attachment, patient raises arms sideupward.

Apparatus:

1. Indian clubs (especially arm circles), wands, bells.

2. Pulley weights.

3. Punching bag.

4. Stall bar and horizontal bar.

5. Ladder.

6. Rowing machine.

Games:

Throwing games as at a target, baseball, basketball, etc., quoits, bowling, organized group games, as dodge ball, baseball, relays, whip tag, etc., athletics, as shot put, hurl ball, throw, etc. may be used to advantage.

(k) *Elbow*

1. Free-arm movements—1. Stretching movements (straightening and thrusting) in all directions.

2. Throwing movements.

3. Pitching and catching.

4. Boxing movements.

Special exercises:

1. Upper arm on table. Operator holds shoulder and wrist. Patient flexes and extends elbow without or with resistance.

2. Patient bends elbow until hand touches the shoulder prone and supine without or with resistance.

3. Patient sits with forearm on lap, palm up, and resists pronation.

4. Patient sits with forearm on lap, palm down—resist supination.

5. Operator sits and faces patient, grasping his hand, palm to palm, patient's arm and forearm kept at right angles and so fixed to prevent rotation of shoulder. Operator twists wrist for pronation and supination. Also flex and extend. Also resist these movements on part of the patient.

Apparatus:

1. Indian clubs (especially forearm and hand circles), wands, bells.

2. Pulley machine.

3. Rowing.

Games:

Throwing games, as baseball, basketball, dodge ball, quoits, ring toss, battle ball, etc., as under shoulder exercises and events as shot-put, bag punching, throw for distance are helpful.

(l) Wrist

Free movements:

1. Flexion, extension, abduction, adduction, circumduction (circling) of wrists.
2. Open and close fingers, also combine with arm movements.
3. Shake wrists.
4. Throwing movements.

Special exercises:

1. Patient sits with forearm on lap, palm up, and resists pronation.
2. Patient sits with forearm on lap, palm down, resists supination.
3. Operator sits facing patient, grasping his hand, palm to palm, patient's arm and forearm kept at right angles and so fixed to prevent rotation of shoulder. Operator twists wrist for pronation and supination. Also flex and extend. Also resist these movements on part of the patient.
4. Operator grasps the fist of the patient with one hand, steadying forearm with the other and flexes, extends, abducts, adducts wrists; strong, firm, slow movement.

Apparatus:

1. Strap patient's forearm to an inclined board and have him turn a wheel each way (circumduction).
2. Strap patient's forearm to board and have him abduct and adduct hand.
3. Patient grasps roller (wrist roller) overhand and winds up a weight without releasing the grasp. Movement is at the wrist, not at the elbow. Reverse for flexion.
4. Indian clubs, especially hand circles, are very helpful.

Games and events:

1. All throwing games as under shoulder, quoits, climbing ropes and poles, etc., should be used.

(m) Fingers

Free movements:

1. Spread the fingers.
2. Open and close fist without and with resistance.
3. Combine opening and closing fists with thrusting movements of arms.
4. Throwing and catching.

Special movements:

1. Operator extends and flexes fingers of patient—assistive, then active, then resistive.
2. Patient touches point of thumb and point of other fingers.
3. Patient places index finger against a peg and spreads fingers—measure. Also measure spread from thumb.
4. Crumple up newspaper.

Apparatus:

1. Pulley weights.
2. Indian clubs, especially in hand circles.
3. Grasping as in climbing pole or rope.

Games and events:

All throwing and catching games, quoits, crokinole, shoot marbles.

PARTIAL LIST OF GAMES AND EVENTS—SUGGESTIVE LIST OF GAMES AND MISCELLANEOUS
EVENTS FOR ORTHOPEDIC PATIENTS SHOWING PARTS INVOLVED AND VIGOR OF ACTIVITIES

[m—mild. M—Moderate. V—Vigorous]

G A M E S	Foot Ankle	Knee	Hip	Trunk	Shoul- der	Elbow	Finger
Base Ball	M	M	M	M	V	M	M
Basket Ball	V	V	M	M	M	M	M
Battle Ball	m	m	m	V	V	M	M
Beandle (Whip Tag)	M	M	M		M	M	M
Black and White	V	M	M	m	m	m	m
Bowling	m	m	m	M	V	V	V
Cage Ball, Push Ball	M	M	M	M	V	M	m
Crookinole							M
Croquet	m	m	m	m	m	m	m
Dodge Ball	M	M	M	M	V	M	m
Dumbbell Tag	M	M	V		V	M	V
End, Cor., Capt. Ball	M	M	M	M	V	M	m
Hand Ball	M	M	M	M	V	M	M
Jump the Shot	M	M	m		m		m
Marbles	m	m	m	m			M
Poison	M	M	M	M	M		V
Quoits	m	m	M	m	M	m	m
Running Relay Races	V	V	V				
Rider Ball	M	M	M	M	m	m	m
Over and Under Relay	V	V	V	M	V	m	m
Soccer	V	V	V	V			
Tag Games	V	V	M	m	V		
Tennis	M	M	V	m	V	M	V
Three Deep	V	V	M		m		
Volley Ball	M	M	M		M	M	M
E V E N T S							
Baseball Throw				M	V	V	V
Batting				M	V	V	V
Bicycling	M	M	M				M
Boxing	M	M	M	M	V	V	M
Chinning (Pull Up)					V	V	V
Climbing, Pole	M	M	V	M	V	V	V
Fence Vault	M	M	V	M	M	M	M
Hand Wrestle	M	V		M	V	M	V
Hop, Skip and Jump	V	V	V	m	M	m	m
Hurdling	V	V	V	M	M	M	
Hurl Ball, Throw	M	M	M	V	V	V	V
Indian Clubs				m	V	V	V
Jumping Rope	V	V	M		M	M	m
Jumps, Broad, High	V	V	V	M	M	M	
Kicking, Football	V	V	V				
Medicine Ball				V	V	M	m
Paddling				M	V	V	V
Pony Race	V	M	M	M	M	M	m
Potato Race	V	V	V	M	m	m	m
Punching Bag	M	M	M	M	V	V	m
Rowing		M	M	V	V	V	V
Running Races	V	V	V	M	M		
Sack Race	V	M	M	M			M
Shot Put	M	M	M	M	V	V	m
Swimming (With Care)	m	M	V	M	V	M	m
Wands					V	M	M

NOTE.—Apparatus exercises, games, and events may be analyzed and activities selected according to disability and size of group.

Gymnasium apparatus.—Arm machine, balance boards, flying rings, giant stride, horizontal bar, hitch and kick, Indian clubs, ladders, parallel bars, pulley weights, stall bars, buck, wrist machines.

Equipment for the above activities includes: Bean bags, basket, volley, soccer, medicine, base and tennis balls, Indian clubs, triplicate pulling weights, baseball bats, punching bag and drum, hurl ball, cage ball, 8 and 12 pound shot, jump standards, and quoit sets.

Rehabilitation monograph. Joint Series No. 35.

Unit Course—Automobile Mechanics I

ENGINE REPAIRING, SECTION 1

February, 1919—Trial Edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is designed to train men in the general repair and upkeep of the gasoline automobile engine.

It is desirable that the student have some knowledge of the gasoline engine, but one with a common school education and experience in ordinary machine work should have no trouble in mastering this work.

2. AIMS OF THE COURSE

The aims of the course are—

- (a) To acquaint the student with the construction and adjustment of the modern gasoline engine.
- (b) To give him practice in the repair and fitting of the various parts necessary to cause the engine to function properly.
- (c) To make him familiar with the various types of engines in common use.

3. LENGTH OF THE COURSE

The course is intended to cover about 30 hours of instruction, study, and laboratory work by the student, and is so arranged that certain exercises may be omitted at the discretion of the instructor should the student have had previous knowledge of the work covered in these exercises.

4. OUTLINE OF COURSE

In a course of this kind it is necessary that the student understand the cycle of events that take place in the engine, as only with this understanding can he develop judgment and skill to make him successful in the work.

The automobile to-day is of the four-stroke cycle type, and may be classified according to its mechanical construction.

The exercises for the student are intended to cover these various types, and may be used with any one type of engine with good results.

Lessons

1. Classification of engines, according to cycle of operation, valve arrangement, cylinder castings, method of cooling, and lubrication.
2. The name and location of the engine parts.
3. General study of an automobile engine.
4. The study of the valve gear.
5. Study of cylinders to determine the construction and condition.
6. Valve grinding and repairing.
7. Piston and connecting-rod repairs.
8. Fitting piston rings.

5. GENERAL SUGGESTIONS TO THE TEACHER FOR CONDUCTING THIS WORK

1. The student should have a thorough knowledge of the principles of the gas engine in order that he may fully appreciate the results that may be expected of the engine. It is therefore suggested that this part of the work be taken up in the form of lectures, using a sectioned engine for demonstration.

2. Demonstrate and explain the use of the various tools. Insist on the student using the proper tools, and that open-end or socket wrenches that exactly fit the nut or bolt be used when possible. When necessary to use an adjustable wrench, insist that it be adjusted to the nut that is being removed.

3. See to it that each student does all the work called for in each exercise and do not take his word for it that he knows. Make him show you.

4. See that the student takes only the necessary tools needed for the work he is doing, and insist upon these tools being wiped up and returned when the student is finished with them.

5. Give as much individual instruction as possible, and encourage the student to ask questions pertaining to the work he is doing.

Suggestions for teaching Lesson I

1. Explain in detail the four-stroke cycle principle, using engine model.

2. Bring out the fact that regardless of structural features the events are the same in all engines of this type.

3. Explain various methods of mounting valves, such as removable valve seat, valve cage, etc.

4. Explain various methods of casting cylinders.

5. Show why cooling by water or forced air circulation is necessary.

6. Give average compression pressures and average explosion temperatures.

7. Compare various lubricating systems and point out advantages and disadvantages of each.

8. Check up answers to questions handed in by student, and if incorrect return for correction.

Suggestions for teaching Lesson II

1. By use of the engine model explain and locate each part of the engine and explain its function.

2. Call attention to the different types of piston rings.

3. Do not go into the mechanical construction of the various carburetors. Simply show the principles of carburation, explain the meaning of rich and lean mixtures, and means of determining whether a mixture is rich or lean—i. e., back firing through carburetor for lean mixture and heavy black smoke for rich mixture.

4. Explain the necessities of ignition, time for ignition to take place, and the construction and adjustment of the spark plug.

5. Explain the difference between the magneto and battery systems of ignition.

Suggestions for teaching Lesson III

1. Explain the names and uses of the various tools.

2. Explain the necessity of an exhaust manifold to carry off the burned gases. Call attention to the construction.

3. Trace the passages in the cylinder castings for the distribution of gas to the various cylinders.

4. Show how to locate top dead center for the different cylinders.

5. Explain the necessity of labeling the wires from the distributor to spark plug. Caution student about removing spark plugs. Show how to adjust spark plugs.

6. Follow the events that take place in the engine cylinder, showing the position of valves for each event.

7. Show how the firing order can be determined by watching the action of either the intake or exhaust valves.

8. See that all parts removed are put in boxes or pans provided for them.

9. Insist on each student cleaning and returning all tools used.

Suggestions for teaching Lesson IV

1. Explain why cover plates are used to deaden valve noises and hold oil.
2. Explain and demonstrate the use of thickness gauge for measuring valve clearances. By means of sketches on blackboard show different types of valves and valve operating mechanisms.
3. Explain why valve clearance is necessary.
4. Demonstrate use of valve lifter.
5. Call attention to valve trouble, and by use of old valves show the various troubles, such as warping, pitting, etc.
6. Explain why exhaust valve springs are heavier than those used on the intake valves; also, why springs are necessary at all. Caution student about mixing these valve springs.
7. Trace method of oiling valves, valve push rods, etc.

Suggestions for teaching Lesson V

1. Trace water-jacket openings through engine.
2. Explain the advantages of the detachable head.
3. Explain the micrometer and how it is read, and show how a cylinder is measured to find if it is worn.
4. Call attention to the condition of cylinders (using old cylinders).
5. Insist that each student exercise special care in working on cylinders, in order not to mar them.

Suggestions for teaching Lesson VI

1. Demonstrate how valves are ground, showing the different methods used to determine their condition.
2. Have each student examine several valves and report their condition to the instructor.
3. Have each student grind several valves.
4. Test the work when finished.
5. Explain the necessity of keeping grinding compound away from the engine cylinder and other working parts.

Suggestions for teaching Lesson VII

1. Explain the crank case necessary with different oiling systems.
2. Demonstrate how pistons are removed.
3. Explain the use of shims.
4. Explain the castellated nut and why it is used.
5. Remove wrist pin showing how it is fastened to cylinder.
6. Remove wrist-pin bushing.
7. Explain why end play is necessary between connecting rod and cylinder.
8. Discuss the various types of pistons, and the clearance necessary for cast iron and aluminum pistons.
9. Explain why a piston is smaller at the head than at the skirt.

Suggestions for teaching Lesson VIII

1. Explain different kinds of piston rings.
2. Explain how piston rings should be set to prevent leaking of gas past piston.
3. Demonstrate the fitting of a piston ring.
4. Explain why pistons are sometimes worn out of round.
5. Explain the meaning of piston slap.

6. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop practice are available, it is recommended that final rating be recorded as follows: The average student will be rated good; the student of exceptional ability will be rated excellent; while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in the commercial shop should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

1. *Execution of work*

(a) *Time*.—Is the student rapid, moderate, or slow in executing his work?

(b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

2. *Finished product*

(a) *Accuracy*.—Should be determined by the record kept of errors in measurement, omissions of dimensions, or lines, etc.

(b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.

(c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

3. *Interest*

(a) *Attitude toward work*.—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?

(b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?

(c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

4. *Test problem*

A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

7. REFERENCE BOOKS FOR TEACHERS

Dyke's Automobile and Gasoline Engine Encyclopedia, 1918, 7th edition. A. L. Dyke, publisher, St. Louis, Mo. Price, \$3.

The Gasoline Automobile, 1st edition, 8th impression, 1915. Hobbs & Elliott. McGraw-Hill Book Co. (Inc.), publishers, 239 West Thirty-ninth Street, New York, N. Y.

Lubrication of the Automobile.—No. 1, The Engine. Folder by Vacuum Oil Co., New York. These folders furnished free.

8. EQUIPMENT AND MATERIAL

1. Sectioned model of a modern gas automobile engine (preferably a T-head type, fitted with circulating pump for both oil and water).

One 4-cylinder 4-cycle T-head engine.

One 4-cycle 4-cylinder L-head engine.

One 4-cylinder 4-cycle I-head engine.

Above engines are to be equipped with carburetors and ignition systems.

Assortment of cylinder castings fitted with valves.

Pistons to fit above cylinder castings.

Connecting rod for pistons.

One outside micrometer, 3 to 5 inches, adjustable.

One inside micrometer, 3 to 5 inches, adjustable.

One outside micrometer, 1 inch.

One outside micrometer, 2 inches.

Two outside calipers, 6 inches.

Two inside calipers, 6 inches.

One thickness gauge, 0.003 inch to 0.025 inch.

One set of open-end wrenches.

One set of socket wrenches.

Two 6-inch monkey wrenches.

Two 10-inch monkey wrenches.

One dozen files, assorted.

Two ball pen hammers.

Two pair pliers, adjustable.

Two pair pliers, cutting.

One valve lifter.

One workbench.

Two bench vises, fitted with copper or lead jaws.

One set of chisels and punches, assorted.

One can Clover Leaf valve-grinding compound.

One box assorted lock washers.

One box assorted cotter pins.

One box assorted castellated nuts.

Assorted bolts and cap screws.

Paper for gaskets.

Shellac.

One set of drills.

One set of taps and dies.

Emery cloth, 0.00 to 1.

Spark-plug wrenches.

Hack saw and blades.

One thread gauge.

One set adjustable reamers, $\frac{1}{4}$ to 1 inch by $\frac{1}{8}$.

Wire.

LIST OF PROPOSED UNIT COURSES ON GENERAL AUTOMOBILE REPAIRING FOR STANDARD
PASSENGER CARS

[Revision of December 31, 1918]

Unit course:	Hours
1. Engines, Part I.....	24
2. Engines, Part II.....	24
3. Upkeep and repair of the passenger automobile (for the present or prospective owner of an automobile who expects to care for his own car).....	30
4. Upkeep and repair of the Ford automobile for owners.....	20
5. Carburetors.....	5
6. Ignition.....	20
7. Cooling systems.....	10
8. Starting and lighting systems.....	30
9. Clutch.....	10
10. Transmission.....	10
11. Rear-axle drive.....	20
12. Running gear.....	24
13. Tire repairing.....	15
Total.....	242
14. Radiator repairing: For the man preferably with some experience in soldering, brazing, and working in sheet metal who wishes to become a specialist in radiator work.	
15. Gas-engine science: A short course of lectures and experiments for the prospective chauffeur or owner or operator of marine or stationary gas engine who wishes to acquire a clear understanding of the fundamental principles of the internal- combustion engine. Requires no previous automobile experience.	
16. Storage batteries: For the man with some electrical and automobile experience who wishes to become a specialist in storage-battery repairing.	
17. Garage organization and management.	
18. Records, cost-keeping systems, etc.	
19. Accounts for automobile-garage keepers.	
20. English for automobile workers.	

PART 2. STUDENTS' INSTRUCTION SHEETS

These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS TO STUDENTS

1. Keep all tools in good order, and always clean them before putting away.
2. Look for manufacturers' marks when removing parts from engine.
3. When necessary, label or tag pieces removed, so that no time will be wasted in locating their proper position when replacing.
4. Select tools that are intended for the operation that you are doing.
5. A wrench of any kind was never intended to be used as a hammer.
6. Patience and practice are necessary to develop judgment and skill. Never say, "That is good enough," but say, "That is just right."
7. Clean and oil all parts before replacing.
8. Do not use waste in cleaning pistons, piston rings, or cylinders, as lint is left on the work. Use cheesecloth or old cloths.

9. Ask questions about the work you are doing. The instructor is always glad to answer each and every question pertaining to the work.

10. Be orderly and neat. This is the greatest aid to speed.

LESSON I

Problem.—Classification of engines, according to cycle of operation, valve arrangement, cylinder castings, method of cooling, and lubrication.

1. The four-stroke cycle.

Dyke, pages 57 to 61, inclusive.

Hobbs & Elliott, pages 25 to 28, articles 21 to 24.

2. Valve arrangements.

Dyke, page 80, Figures 1, 3, 4, 5, 7.

Dyke, page 81, types of cylinders.

Dyke, page 532, advantages of T-head cylinder.

Hobbs & Elliott, page 32, Figures 42, 43, 44, 45.

Hobbs & Elliott, page 33, article 28.

3. Cylinder castings.

Dyke, page 80, chart 37.

Dyke, page 81, types of cylinders.

Hobbs & Elliott, pages 50 to 56, article 41.

4. Method of cooling.

Dyke, pages 185 to 189.

Dyke, page 69.

Hobbs & Elliott, page 56, Figure 67.

Hobbs & Elliott, page 40, article 36.

5. Method of lubrication.

Dyke, pages 195 to 200.

Hobbs & Elliott, pages 106 to 112, articles 80, 81, 82.

Report (give brief answers to the following questions):

1. How can you tell an L-head engine?
2. Why is it necessary to cool an engine?
3. What are the advantages of the T-head construction? The disadvantages?
4. How are pistons and cylinder walls lubricated?
5. Is it possible to give an engine too much oil? Why?
6. Explain the thermosyphon cooling system.
7. Where are the valves located in an I-head motor?
8. What is the function of a circulating pump?

LESSON II

Problem.—To learn name and location of engine parts.

1. The four-cycle engine and its parts.

Dyke, page 54, chart 26 (study the chart carefully, note the name and location of each part).

Hobbs & Elliott, page 26, article 23.

2. Carburetors: The function of the carburetor and its principle of operation.

Dyke, pages 141, 142, 143, 144, chart 72.

Hobbs & Elliott, page 79, articles 54, 55.

3. Ignition.

Dyke, pages 67, 68, 69, and 84, spark plug.

Hobbs & Elliott, page 39, article 33.

Report (give brief answers to the following questions):

1. Of what material are pistons made?
2. What is the function of the carburetor?
3. Why is it necessary to advance the spark as engine speeds up?
4. How many piston rings are used on the average piston?
5. Where is the spark plug generally located? Why?

LESSON III

Problem.—General study of an automobile engine.

Apparatus: One engine (mounted on stand). Necessary tools to be obtained from tool room as their need becomes apparent.

Method of procedure: 1. Note the number of cylinders and their arrangement, paying particular attention to the location of valves, spark plug, and method of cooling.

2. Remove exhaust manifold. (In dismantling any engine always note manufacturer's assembly marks on parts, so that there will be no question as to their relative position when assembling. Take especial care in laying parts away when removed, in order that small parts are not mislaid. Always replace cap screws, bolts, nuts, etc., after removing parts. Much time may be saved by following this procedure.)

Note construction of manifold, material, and method of fastening to the cylinders.

Dyke, page 82.

3. Remove carburetor and intake manifold. Note arrangement for distributing gas to the cylinders.

Dyke, page 82.

4. Determine location of piston in No. 1 cylinder when spark occurs. Note location of ignition and method of driving same. Remove spark plugs, ignition system, and wiring.

5. Follow events of cycle in one cylinder by watching motion of pistons and valves.

Hobbs & Elliott, page 26, articles 23, 24.

6. Determine firing order.

Dyke, pages 117 to 122.

Place parts removed in a box or pan provided for them. Do not replace parts on engine.

Report (give brief answers to the following questions):

[Give list of tools used in performing this exercise]

1. Name of engine.
2. Type (L, T, I, or F.)
3. Number of cylinders.
4. Arrangement of cylinders (cast singly, in pair, or en bloc).
5. Method of cooling (does cooling water jacket extend to bottom of cylinder?).
6. Location of carburetor.
7. Location and make of ignition system or magneto.
8. Position of piston in cylinder No. 1 when spark occurs.
9. Give method of determining direction of rotation.
10. Firing order.
11. Method of determining firing order.

LESSON IV

Problem.—The study of the valve gear.

Apparatus: Engine used in Lesson III. Necessary tools.

Theory: In order that the cycle of operation may be carried on within the cylinder of the engine it is necessary that the valves admitting the fuel mixture and exhausting the burned gases operate at certain definite intervals with respect to the piston travel. The valves are actuated by lifters which receive their motion either from push rods or directly from the cams, depending upon the design of the engine. There is a positive connection between the movement of the cams and the rotation of the crank shaft, hence the direct relation between the operation of the valves and the piston position.

Method of procedure.—1. Remove cover plates from valve.

Dyke, page 631.

2. Determine valve clearances for all valves. (Use thickness gauge.)

Dyke, pages 94 and 634, valve adjustments.

3. Determine position of piston No. 1 with regard to top center when exhaust valve is just closed. (Check position of all pistons.)

4. Remove valves from one cylinder. (If engine is of the detachable head type, the cylinder head must be removed. Use valve lifter in removing valves.)

5. Note type of valve used.

Dyke, page 94, Figure 7.

6. Examine valves for wear and defects.

Dyke, page 630, valve troubles.

7. Note the relative strength of exhaust and intake valve spring.

8. Note method of securing spring on valve stem.

9. Note method of lubrication of valve parts.

Do not assemble.

Report (give brief answers to the following questions):

1. Give clearances for all valves in thousandths of an inch.

2. Why is a valve clearance necessary?

Dyke, page 95.

3. How is it adjusted?

Dyke, page 94, Figure 5.

4. What is the proper valve clearance for this engine?

Dyke, page 542, chart 228.

5. Give location of piston No. 1 when exhaust valve is just closed.

6. Are the exhaust and intake valve springs the same?

7. Of what material are the valves made?

8. Are they of one or two piece construction?

9. Is the seating surface beveled or straight?

10. Why are valve springs necessary?

LESSON V

Problem.—Study of cylinders to determine the construction and condition.

Apparatus: Engine used in Lessons III and IV. Necessary tools.

Theory: The cylinders provide the space in which the fuel in gaseous form is compressed and exploded. It should be of such shape that the cycle of operation may be carried on most efficiently—i. e., small combustion space and proper bore to stroke ratio. The cylinder walls should be of sufficient strength to withstand the extreme pressure developed and provided with some means of disposing of the heat resulting from the combustion of the fuel.

Procedure: 1. Remove cooling water connections. Note location and how fastened to cylinders. (Replace bolts or nuts.)

2. If engine is not of the detached head type, remove cylinders.

3. Observe material and construction of cylinders.

4. Measure cylinder bore (use an inside micrometer).

Dyke, page 81.

5. Note condition of cylinders.

Dyke, pages 201, 202.

6. Trace path of cooling water through water jacket of engine (especially around valves).

Report (give brief answers to the following questions):

1. How are cylinders fastened to crank case?

2. Of what material are they made?

3. Where does water enter and leave cylinders?

4. Is a circulating pump used?

5. What is the bore of the cylinder?

6. Are all cylinders the same diameter (exactly)?

7. Are the cylinders perfectly round?

LESSON VI

Problem.—Valve grinding and repairing.

Apparatus and tools: Engine; valve-grinding compound; grinding tool; oil can with gasoline.

Theory: In order that the engine may deliver its full power, it is necessary that the valves seat properly, and that when closed there is no leaking of gas past them.

Procedure.—1. Remove valves from engine. (Note carefully the marking of valves so that they can be replaced in their proper places.)

2. Mark exhaust and intake springs.
3. Examine valves carefully.

Dyke, page 630, valve troubles.

4. Test valves with Prussian blue.

Dyke, page 630.

5. If valves are warped, reseal.

Dyke, page 630.

6. If pitted, regrind.

Dyke, pages 630, 631, 632, 633.

7. Examine valve guide for wear.

Dyke, page 634, valve guides.

NOTE.—To determine if valves are properly ground, replace in proper position with springs, and test with gasoline. With valve seated, squirt a little gasoline around valve and watch to see if it leaks by valve. If not, valve is O. K. If leak occurs, valve is not ground sufficiently. Continue operation until all valves seat properly.

Have instructor O. K. work.

LESSON VII

Problem: Piston and connecting rod repairs.

Apparatus: Engine, and necessary tools.

Theory: The piston and connecting rods deliver the power to the crank shaft, and are subject to great strain. It is necessary that they fit properly to give good results.

Procedure.—1. Draw oil from crank case.

Dyke, page 621, Figure 2.

2. Remove crank case from engine. (Replace bolts and nuts.)

3. Remove piston and connecting rod from one cylinder.

Dyke, page 646, Figure 4.

In removing piston, care must be taken not to let it come in contact with any hard substance that will mar it. After removing piston, replace shims and bearing cap in the proper place.

Dyke, page 641, Figure 14.

4. Remove wrist pin from piston.

Dyke, page 650, Figure 22.

5. Note method of fastening wrist pin in piston.

6. Remove wrist pin bushing.

Dyke, page 644, Figures 1, 2, 3.

7. Try wrist pin in wrist pin bushing for fit, and if found loose, fit new bushing in place.

Dyke, page 644.

8. If wrist pin is worn, replace.

Report (Give brief answers to the following questions):

1. What is the shape of the piston top?
2. Of what material is wrist pin bushing made?
3. What provision is made for oiling?
4. Is wrist pin hardened? Why?
5. Why is the side play allowed between connecting rod and piston?

LESSON VIII

Problem: Fitting piston rings.

1. Size of the piston.

Dyke, page 651, pages 645, 588, 75.

Measure diameter of piston at top and bottom.

2. Piston rings. (Why necessary?)

Dyke, page 75.

3. Types of piston rings.
Dyke, pages 651, 654, 75, 655.
4. Remove piston rings. (Mark rings to insure replacing in proper grooves.)
Dyke, page 657.
5. Clean grooves and rings.
Dyke, page 656.
6. Replace rings and determine if they fit properly.
Dyke, pages 656, 657.
7. If necessary, fit new rings.
Dyke, pages 567, 658.

Report:

1. Diameter of piston at top and bottom?
 2. Is this piston the proper size for cylinder?
 3. How many rings are used in each piston?
 4. What is meant by eccentric piston rings?
 5. Do rings fit cylinder properly?
 6. Do rings fit piston properly?
 7. How would you remove rings from piston?
 8. Of what material are piston rings made?
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Rehabilitation monograph. Joint Series No. 36.

Unit Course—Power Plant Operating I—Starting Up and Shutting Down the Steam Plant

STARTING UP AND SHUTTING DOWN THE STEAM PLANT

February, 1919—Trial edition

PART 1. MANUAL FOR INSTRUCTOR

1. QUALIFICATIONS OF STUDENT

The student should be serious in his desire to undertake the study of this subject. The conditions under which a power plant operator is employed require a man of even temperament and keen judgment in order to meet emergencies. If the student appears to be impulsive or of a care-free nature, he should be discouraged in the selection of this work, as the responsibilities are relatively great as compared to other mechanical vocations.

No previous experience is required but some general knowledge of the construction of boilers or engines is desirable in view of the broad field covered by this subject and the limited time of instruction.

Men afflicted with lung trouble should not take this course.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

It is the primary aim of this course to give a general idea of the operation of the fundamental units in a steam power plant. It is not to be assumed that an "engineer" can be trained in such a short period of time. The course should serve as an introduction to the duties in the care and maintenance of a simple steam power plant in which the following points should be emphasized: *Safety, economy, and continuance of operation.*

The term "steam power plant" in this course refers to the most simple type, i. e., boiler feeder, boiler, steam lines, and simple engine. The term "operation" includes filling boiler, building fire, getting up steam, heating lines to engine and pump, starting up engine and shutting down of same.

Upon the completion of this course the student should have a foundation upon which it will be possible for him to build up his own knowledge of this subject so that in assuming a subordinate position in a power plant, he may be expected to advance more rapidly to a position of responsibility. Additional unit courses of this series will help him to achieve this end.

3. LENGTH OF COURSE

This course is intended to cover about 30 hours of instruction, study, and practical work by the student.

4. EQUIPMENT

It is assumed that the power plant of the reconstruction hospital or of the vocational or trade school will serve as a laboratory for the actual work of the student. Trade catalogues should be provided to aid the student in the study of the various parts of the equipment. A list of manufacturers of the various equipment found in a steam plant is given herewith. The instructor may obtain descriptive literature and catalogues by communicating with these or other firms.

Boiler feed pumps:

A. S. Cameron Steam Pump Works, 11 Broadway, New York, N. Y.

Worthington Pump & Machinery Corp., 115 Broadway, New York, N. Y.

Injectors:

Hancock Inspirator Co., 119 West Fortieth Street, New York, N. Y.

Penberthy Injector Co., Detroit, Mich.

Boilers:

Babcock & Wilcox, 85 Liberty Street, New York, N. Y. (Publish a good book, "Steam," for advertising purposes.)

Wickes Boiler Co., Saginaw, Mich.

Engines:

Allis Chalmers Manufacturing Co., Milwaukee, Wis.

Ball Engine Co., Erie, Pa.

Gauges:

Crosby Steam Gauge & Valve Co., Boston, Mass.

Traps, etc.:

Crane Co., Chicago, Ill.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination. Until more definite scales for rating for power plant operating are available, it is recommended that final rating be recorded as follows: The average student will be rated "good," the student of exceptional ability will be rated "excellent," while the student of lesser ability will be rated "fair." The student producing work of a quality that would be rejected in the commercial shop should be rated "poor."

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- (1) Execution of work:
 - (a) Time—Is the student rapid, moderate, or slow in executing his work?
 - (b) Technique—
 - Does the student use workman-like methods?
 - Does he exercise reasonable economy in use of materials?
 - Is he neat and orderly in care of tools?
- (2) Finished product:
 - (a) Accuracy—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.
 - (b) Quality—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
 - (c) Mastery of principles—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?
- (3) Interest:
 - (a) Attitude toward work—
 - Does the student love his work or does he watch the clock?
 - Is he likely to continue in this line of work?
 - (b) Studiosness—
 - Does the student show disposition to study the printed literature related to this work?
 - Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) Possibilities of growth—Is the student likely in due time to receive promotion to positions of greater responsibility?
- (4) Test problem—A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

6. OUTLINE OF COURSE

The results obtainable from this course are largely dependent upon the imparting of direct practical knowledge to the student by the instructor. It seems impossible at the present time to prescribe any standard textbook or reference as an assignment for study, due to the general form of instruction. (The "Handbook on Engineering" by Henry C. Tulley, published by McGraw Hill Book Co. (Inc.), New York City, might be used as a reference by the instructor but can not be recommended as an up-to-date publication.)

The subject matter of the course has been divided into seven lessons in the outline which follows. This outline should be used as a basis for practical talks to precede the task assigned the student for each lesson. It would be advantageous to make these talks very informal, and in the boiler room or engine room, so that the various points covered may be demonstrated. Acquaintance with the questions asked on the students' instruction sheets will assist the instructor in covering points given in the outline for each lesson.

To insure results, each student should be provided with a notebook in which he ought to be required to take notes of all important points during the practical talks. These notes, with trade catalogues, offer him a study in preparation for the task to be performed. It is preferable to have the student write answers to all questions on each instruction sheet before proceeding with the next lesson.

OUTLINE OF PRACTICAL TALKS

Lesson I.—Introduction to a steam power plant

A. Purpose:

1. Generation of power.

B. Realization of responsibilities:

1. Safety (boiler explosions, engine accidents, etc.).
2. Economy (waste of coal, water, steam).
3. Continuance of operation (shutdown of plant).

C. Source of power:

1. Heat energy in coal (indicate supply).

- D. Method of converting heat energy into power:
 - 1. Boiler generation of steam (show boiler in operation).
 - 2. Engine producer of mechanical power (show engine in operation).
- E. Continuance of operation:
 - 1. Coal supply (method of handling).
 - 2. Water supply (indicate supply).
 - (a) Boiler feeder (show pump or injector in operation).
- F. Necessity of thorough acquaintance with all details of plant.

Lesson II.—Boiler feeder

- A. Purpose:
 - 1. Continuous supply of water to boiler.
 - (a) Operation against boiler pressure.
- B. Reliability:
 - 1. Necessity of water supply.
 - (a) Precautions in case of failing (cover fire).
- C. Forms of boiler feeders:
 - 1. Pump—
 - (a) Reciprocating—
 - Power driven—
 - Motor.
 - Belt.
 - Direct steam driven—
 - Simplex.
 - Duplex.
 - (b) Centrifugal—
 - Turbine driven.
 - Motor driven.
 - 2. Injector—
 - (a) Automatic (Penberthy).
 - (b) Positive (Hancock).
- D. Designation of size:
 - 1. Capacity in gallons or pounds per minute.
 - 2. Dimensions, diameter steam cylinder by diameter water cylinder by length stroke.
- E. Operation:
 - 1. Path and action of steam in pump or injector.
 - 2. Path and action of water.
- F. Control:
 - 1. Speed and capacity—
 - (a) Throttle valve.
- G. Care:
 - 1. Oiling.
 - 2. Packing.
 - 3. Cleanliness.

Lesson III.—Boiler

- A. Purpose:
 - 1. Safe vessel for economically generating steam.
- B. Forms (general):
 - 1. Fire tube.
 - 2. Water tube.
- C. Construction (general):
 - 1. Drum—
 - (a) Strength.
 - 2. Tubes—
 - (a) Location.
 - (b) Removed.
 - (c) Replacement.

C. Construction (general)—Continued.

3. Manholes and handholes.
4. Feed pipe.
5. Steam pipe (dry pipe).
6. Mud drums.
7. Blow off.
8. Steam gauge.
9. Safety valve.
10. Water column—
 - (a) Gauge glass.
 - (b) Gauge cocks.
11. Fusible plugs.
12. Vent.
13. Furnace—
 - (a) Grate.
 - (b) Ash pit.
 - (c) Bridge wall.
 - (d) Baffles.
14. Dampers.

D. Designation of size:

1. Capacity—boiler horsepower.

E. Operation:

1. Path of hot gases from fuel bed.
2. Circulation of water.

F. Care:

1. Water column—gauge cocks (keep clear).
2. Safety valve (working order).
3. Leaks.
4. Cleanliness.

Lesson IV.—Steam engine

A. Purpose:

1. Generation of mechanical power from heat in steam.

B. Forms (general):

1. Simple.
2. Compound.

C. Construction (general):

1. Cylinder.
2. Piston.
3. Piston rod.
4. Cross head.
5. Connecting rod.
6. Crank shaft.
7. Main bearings.
8. Flywheel.
9. Valve—
 - (a) Form {

slide valve.	{
Corliss.	
 - (b) Operation.
 - (c) Setting.

10. Governor.

11. Drains.

12. Lubricators.

D. Designation of size:

1. Cylinder diameter x stroke.
2. Horsepower.

E. Operation:

1. Path of steam.
2. Action of parts.

F. Care:

1. Oiling.
2. Bearings.
3. Packing.
4. Cleanliness.

Lesson V.—Piping

I. Feed water piping:

- A. Suction or supply line—
 1. Effect of leak in suction.
- B. Feed line to boiler—
 1. Controlling valve.
 2. Check valves.

II. High-pressure steam piping:

- A. Stop valves.
- B. Long bends.
- C. Main line to engine—
 1. Allowance for expansion.
- D. Traps (purpose).
- E. Separators (purpose).

III. Exhaust lines:

1. From engine.
2. From pump.

IV. Blow down line.

Lesson VI.—Starting up steam plant

I. Necessity of thorough acquaintance with all parts of plant:

- A. Inspection of boiler externally and internally.
- B. Lighting fire.
 1. Kindling—
 - (a) Wood and oily waste.
 - (b) Fire coal lightly.
 2. Dampers—
 - (a) Back damper open.
 - (b) Ash pit doors open.
 3. Pulling down banked fire—
 - (a) Spread evenly.
 - (b) Fire coal lightly.
- C. Getting up steam—
 1. Proceed slowly—
 - (a) Expansion of parts.
 - (b) Vent open.
- D. Inspection of engine—
 1. Fill oil cups and cylinder lubrication.
 2. Oil all moving parts.
 3. Open drains.
- E. Warming up steam lines—
 1. Crack valves (open slowly)—
 - (a) Warm slowly.
 - (b) Traps operating.
 - (c) Drains open.
- F. Starting engine—
 1. Crack throttle valve—
 - (a) Drains open.
 - (b) Turn over slowly.
 - (c) Warm up.
 2. Gradually open valve wide—
 - (a) Watch governor.
 - (b) Watch lubricators.
 - (c) Close drains.
 - (d) Watch water gauge on separator.

I. Necessity of thorough acquaintance with all parts of plant—Continued.

G. Operating—

1. Close watch of water level—
 - (a) Blow down water column.
 - (b) Try gauge cocks.
2. Control feed water.
3. Keep constant steam pressure.
 - (a) Regulation of draft.
4. Clean fires.
5. Blow down.
6. Lubrication of engine.

Lesson VII.—Shutting down steam plant

A. Shutting down engine:

1. Close throttle valve after taking load off engine.
2. Shut off lubricators.
3. Open drains.
4. Wipe down engine.

B. Shutting down boiler:

1. Fill boiler with water—
 - (a) Close valves to water column.
2. Clean fire.
 - Bank fire—
 - (a) Shove back live coals.
 - (b) Cover with green coal.

LIST OF PROPOSED UNIT COURSES IN POWER PLANT OPERATING

1. *Starting up and shutting down the steam plant.*—Basic unit course, 30 hours.
2. *Starting up and closing down the electric plant.*—Basic unit course, 20 hours.
3. *Pumps, injectors, and water heaters.*—Extension unit course, 20 hours.
4. *Methods of firing with different grades of fuel.*—Extension unit course, 20 hours.
5. *Types of boilers and their construction.*—Extension unit course, 15 hours.
6. *Refrigeration plants.*—Extension unit course, 20 hours.
7. *Elevators.*—Extension unit course, 15 hours. (For men who expect to operate hotel and apartment house plants.)

PART 2. STUDENT'S INSTRUCTION SHEETS

These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS TO STUDENTS

1. Try to realize the responsibilities of a power plant operator
2. Think of the result before performing any operation.
3. Proceed slowly when opening or closing valves.
4. Cleanliness in the boiler and engine rooms tends to make a power plant safe and economical.
5. Keep a complete notebook and use it.
6. Write answers to all questions in each lesson before proceeding with the next task.
7. Study the trade catalogues illustrating the various parts of equipment.

Publications recommended for advanced study:

"Steam Power," by Hirshfeld and Ulbright, John Wiley & Sons (Inc.), publishers, New York, N. Y. Price, \$2.

Read "Power," a magazine published by McGraw Hill Publishing Co., New York, N. Y.

Read "Power Plant Engineering," a magazine published by the Technical Publishing Co., 537 South Dearborn Street, Chicago, Ill.

Lesson I.—Introduction to a steam power plant

A. Object:

To become generally acquainted with a steam power plant. (Various units will be considered in following lessons.)

B. Task:

1. Locate coal storage.
2. Note method of handling coal.
3. Follow the removal of ashes.
4. Locate water supply.
5. Trace supply to boiler feeder.
6. Note form of boiler feeder; pump or injector.
7. Trace water supply to boiler.
8. Note form of boiler.
9. Follow steam line from boiler to engine.
10. Consider relative positions of boiler feeder, boiler, and engine.
11. Trace exhaust from engine.

C. Questions:

1. Where and how is coal stored?
2. Can you suggest any improvement in the handling of the coal?
3. Can you suggest any improvement in the handling of the ashes?
4. Where is the boiler feed water obtained from?
5. Is the feed water heated? If heated, how and why?
6. Is the boiler feeder a pump or injector?
7. What is the shape of the boiler and how is it supported?
8. Where is the engine located?
9. What form of power does it develop; mechanical (belt) or electrical?

Lesson II.—Boiler feeder

A. Object:

To become generally familiar with a boiler feed pump or injector.

B. Task:

1. Note the location of pump or injector.
2. Examine the construction.
3. Determine the size.
4. Study the operation of the feeder; pay particular attention to the action of the valves.
5. Note method of controlling quantity of water handled.

C. Questions:

1. What is the purpose of the boiler feed pump or injector?
2. Will it lift water from a lower level?
3. Why will it force water against a greater pressure?
4. What is the size of the pump or injector?
5. What type of pump is used? Reciprocating? Centrifugal?
6. If injector, tell type. Automatic? Positive?
7. Explain in detail what happens when steam is turned on pump.
8. How can you increase or decrease the amount of feed water handled?
9. How is the pump lubricated.
10. How would you proceed to pack the stuffing boxes on the piston rods?

Lesson III.—Steam boiler

A. Object:

To become generally acquainted with a steam boiler.

B. Task:

Make a general external, and if possible, internal inspection of the steam boiler in order, first, to locate, second, to determine the purpose of, and third, to note the condition of the following parts and fixtures:

1. Drum (size and position).
2. Tubes (method of making tight).
3. Manholes and handholes.
4. Feed pipe.
5. Steam pipe (dry pipe).
6. Mud drums.
7. Blow-off.
8. Fusible plug.
9. Vent.
10. Steam gauge.
11. Safety valve.
12. Water column.
13. Gauge glass.
14. Gauge or "try" cocks.
15. Furnace.
16. Grate.
17. Ash pit.
18. Budge wall.
19. Baffles.
20. Dampers.

C. Questions.

1. Name of the type of boiler examined—water tube or fire tube?
2. How can the tubes be removed and replaced?
3. Where are the manholes located and how are they kept tight?
4. When is the vent used?
5. How is the steam gauge connected to the boiler?
6. Explain the operation of the safety valve.
7. How can you regulate the safety valve to blow off at different pressures?
8. How is the water column connected to the boiler?
9. Do these connections ever become clogged?
10. How can a gauge glass be replaced?
11. Why are gauge cocks necessary when a gauge glass is used?
12. Are the grates stationary? If so, how is fire cleaned?
13. Where does air enter the furnace?
14. How is the amount of air that enters controlled?
15. How can you make the boiler generate steam at a faster rate?
16. Explain how you would clean soot from the heating surface of a boiler?
17. How can boiler scales be removed?

Lesson IV.—Steam engine

A. Object:

To become thoroughly acquainted with a simple steam engine.

B. Task:

Make a general external, and if possible, internal inspection of the steam engine in order, first, to locate, second, to determine the purpose of, and third, to note the condition of the following parts:

1. Throttle valve.
2. Cylinder.
3. Piston (rings).
4. Piston rod.
5. Crosshead.
6. Connecting rod.
7. Crank shaft.
8. Flywheel.
9. Valve (operation and setting).
10. Governor.
11. Drains.
12. Lubricators.

C. Questions.

1. Of what type is the engine—simple? Compound?
2. What form of valve is used—slide valve? Piston valve? Corliss?
3. Trace the path of the steam through the engine.
4. What prevents steam from leaking past piston?
5. What will cause an engine to knock?
6. How can this trouble be remedied?
7. How does the governor control the speed of the engine?

Lesson V.—Piping

A. Object:

To become acquainted with the general piping layout of a simple power plant.

B. Task:

1. Trace all water piping to and from pump or injector.
2. Note style of valves used in water lines—globe, gate, check.
3. Determine the purpose of every valve in the water lines, paying particular attention to those on feed line to boiler.
4. Trace all steam lines from boiler to pumps and engines.
5. Note style of steam valves used—globe, gate, automatic stop.
6. Determine the purpose of *all* steam valves.
7. Note arrangement of steam piping from boiler to engines and pumps to allow for expansion.
8. Locate traps, if any, and study their operation.
9. Examine separator and note location.

C. Questions:

1. Why are steam traps used?
2. What is the difference between a steam trap and a separator?

Lesson VI.—Starting up a steam plant

A. Object:

To become acquainted with proper method of starting up a steam plant.

B. Task:

1. Have boiler filled with water.
2. Test height of water in boiler.
 - (a) Drain water column.
 - (b) Use gauge or dry cocks.
3. Light fire.
4. Heat up boiler *slowly*.
5. Warm up steam lines *slowly*.
 - (a) Give time for expansion of line.
 - (b) Make allowances to drain condensation.

B. Task—Continued.

6. Open drains on engine.
7. Warm up engine.
8. Fire boiler to maintain steady steam pressure.
9. Watch water level in boiler.
10. Watch lubrication of engine.

Lesson VII.—Shutting down steam plant

A. Object:

To become acquainted with proper method of shutting down steam plant.

B. Task:

1. Close throttle valve on engine *after* load has been taken off.
2. Shut off lubricators.
3. Open drains.
4. For overnight shutdown:
 - (a) Bank fire.
 - (b) Open back damper slightly.
5. Shutdown for boiler repairs:
 - (a) Draw fire.
 - (b) Open vent (in case of rapid relief of pressure).
6. Wipe down engine.
7. Clean furnace.
8. Clean boiler.

Rehabilitation monograph. Joint Series No. 37.

Unit Course—Bookkeeping 1—Instructors' Guide

BOOKKEEPING

February, 1919—Trial edition

INTRODUCTORY EXERCISES IN BOOKKEEPING, WITH SIMPLE METHODS OF KEEPING ACCOUNTS
FOR A BUSINESS ENGAGED IN TRADE

A. QUALIFICATIONS OF STUDENTS

This course is intended for men having a grammar school education or its equivalent.

B. AIM OF COURSE FOR STUDENTS

It provides introductory exercises in bookkeeping and includes simple methods of keeping accounts for a trading concern. This unit also includes the first principles of bookkeeping, which are a necessary foundation for unit 2, which follows this unit. The material given in units 1 and 2 together would enable a man to become an assistant bookkeeper for a small business with a single proprietor. Units 1, 2, and 5 together will prepare one to keep a partnership set of books under supervision.

C. BRIEF DESCRIPTION OF UNIT

The exact material included in unit 1 will depend upon the textbook selected. See (g) in paragraph E. If one chooses a textbook which uses the account method or journal method, this unit will include how to keep an account with cash, customers, creditors, merchandise (inventory, purchases, and sales), expenses, and capital. It will also include simple methods of recording business transacted in the journal, purchase book, and sales book. Also how to post and obtain a trial balance. If one chooses a text beginning with the balance sheet or statement method, he will acquire a working acquaintance with such terms as assets, liabilities, capital, property (fixed and floating), accounts, and notes receivable and payable, interest, inventory, and other terms necessary to enable him to arrange the items properly in preparing a simple statement of financial condition. On completing this unit he should be able to prepare in good form simple statements, lists, inventories, and other simple reports for a small business.

Regardless of the textbook used, the material covered in unit 1 will afford full preparation for unit 2, which follows unit 1.

D. APPROXIMATE TIME

The average student should complete the work in this unit course in approximately 30 hours. The time for each assignment will depend largely on the ability of the student and the text material selected. In general not less than one hour should be given to each assignment. Frequently as much can be accomplished in one period of one and one-half hours as in two periods of one hour each.

E. EQUIPMENT

(a) *Paper*.—The kind and quantity of paper required will be stated in connection with the text and practice material under (g).

(b) *Pencils*.—One No. 2 pencil.

(c) *Penholders and pens*.—A good fountain pen or a penholder with a heavy base and six steel pens (business or school points) should be used.

(d) *Ruler*.—A good 12-inch wood ruler with brass edge should be provided.

(e) *Ink*.—Black or blue writing fluid should be used. All ruling of lines may be done in black ink, thereby dispensing with the use of red ink.

(f) *Blotters*.—One or more blotters should be provided. These should be used freely.

(g) *Textbooks and practice material*. Some standard textbook with its accompanying practice material will be needed to give the instruction of this unit. The textbook selected will depend largely upon two factors: (1) The method by which the instructor prefers to present the unit, and (2) the instructor's individual preference. There are three methods of presenting the first notions of bookkeeping, as follows:

(a) The journal method

(b) The account method.

(c) The financial statement or balance sheet method.

For further details concerning these three methods, see Section G_{below}.

F. LIST OF TEXTBOOKS

The following textbooks have been classified alphabetically according to the journal method, the account method and the balance-sheet method. The work of this unit can be covered by any one of these texts and its accompanying material.

Journal method

1. Ellis Industrial Bookkeeping, Ellis Publishing Co., Battle Creek, Mich.

Material required:

1 outfit, Section I.....	\$2.40
1 guide (textbook).....	1.20
1 book of business directions, beginning section.....	.30
2 pads made-out invoices (Sec. I).....	.24
1 pad students' reports (Sec. I).....	.08
Total.....	4.22
1 teacher's key.	

This text begins with the use of actual business papers and contains sufficient material for unit 1 and unit 2. For unit 1 end the course with transaction 49 of the business directions, which contains all the instructions for the student.

2. Miner and Elwell, Principles of Bookkeeping, Ginn & Co., New York.

Material required:

1 copy "Principles of Bookkeeping," \$1.30.

First course, \$1.12, less 25 per cent.

1 copy teachers' reference book, to be used with "Principles of Bookkeeping."

20 double sheets of journal paper.

10 double sheets of ledger paper.

10 sheets of ruled paper about letter size.

The work for this unit is carried out in this text without the use of business papers. Conclude this unit at page 95.

Several exercises of the same kind are provided for drill. The instructor should not assign more than one exercise of each kind unless the student needs further drill on that point. Give at least one exercise requiring the use of the journal, sales book, purchase book, cash book, and the ledger.

3. H. M. Rowe, Rowe's Bookkeeping and Accountancy, the H. M. Rowe Co., Baltimore, Md.

Material required:

1 copy No. 120A Rowe's Bookkeeping and Accountancy	\$1. 30
1 budget No. 121 elementary set	. 60
1 blank book No. 122	. 45
1 outgoing papers No. 123	. 20
1 set of filing envelopes No. 124	. 05
Total	2. 60
Less 25 % f. o. b. Baltimore	. 65
Net	1. 95
1 teacher's reference book. Also 5 sheets of each, ledger paper and journal paper.	

This budget uses the cash book, purchases book, sales book, and the journal, and also introduces actual business papers from the very beginning. There is sufficient material in this outfit for both unit 1 and unit 2. The course for unit 1 ends with page 40 of budget 121, which contains complete working instructions for the student.

Account method

1. James W. Baker, "Twentieth Century Bookkeeping and Accounting," South-Western Publishing Co., Cincinnati, Ohio.

Material required:

- 1 copy Twentieth Century Bookkeeping and Accounting, elementary part.
- 1 key (teacher's), Part I.
- 12 double sheets ledger paper.
- 12 double sheets journal paper.

This constitutes introductory work without business papers, enabling the student to become familiar with one account at a time, after which he takes up the journal, the purchases book, the sales book, posting, and the preparation of the trial balance. Unit 1 ends with page 46 of the text, which contains full instruction for the student.

2. C. F. Rittenhouse, "New Modern Illustrative Bookkeeping, introductory course," American Book Co., New York.

Material required:

- 1 copy New Modern Illustrative Bookkeeping, introductory course.
- 1 teacher's key.
- 15 double sheets ledger paper.
- 15 double sheets journal paper.

The course begins without business papers, presenting the essentials in the form of a study of individual accounts on the theory that certain fundamental principles and processes must be mastered before the student can undertake intelligently anything in the way of bookkeeping which approaches actual practice.

The work in unit 1 will end at page 50 if only the general journal is used, or at page 81 if the purchases, cash, and sales journal are introduced. Assign only one problem under each exercise unless the student requires more drill work on each topic.

Balance sheet method

1. Albert G. Belding, *Accounts and Accounting*, American Book Co.

Materials required:

- 1 copy Belding's *Accounts and Accounting*.
- 1 teacher's key.
- 15 double sheets of ledger paper.
- 15 double sheets of journal paper.
- 10 sheets of ruled paper about letter size.

This text approaches the study of accounts through the balance sheet and by the double-account method, without the use of business papers. This unit will end with page 37 omitting problem 12 on page 36. In some cases the instructor may find it advisable to omit additional problems of purely drill work.

Instruction may be given by the journal method by beginning on page 41 and continuing to page 79.

2. Lloyd E. Goodyear, *American Bookkeeping Series*, Goodyear-Marshall Publishing Co., Cedar Rapids, Iowa.

Material required:

- | | |
|----------------------------------------------------------------------------------|--------|
| 1 copy Goodyear's <i>Principles, Rules and Definitions for bookkeeping</i> | \$0.60 |
| 1 copy unit 1..... | .25 |
| Total..... | .85 |
| 1 teacher's oral quiz book..... | .10 |
| 1 teacher's key for unit 1..... | |

This material is furnished in the form of a reference book which may be used in succeeding units and a pamphlet of problems requiring the preparation of 10 financial statements, together with the necessary schedules and inventories. All the practice material required will be found in the envelope labeled "Unit 1."

The average time for this unit will be approximately 20 hours. If it is desired to devote 30 hours to this unit, begin on unit 2 by the same publishers.

G. METHOD

The texts listed above provide three distinct methods of presenting elementary bookkeeping, which are here named in the order of their appearance historically in the teaching of bookkeeping:

1. The journal method in which transactions are first written as debits and credits in the journal and then posted to the ledger, after which a trial balance is prepared.

2. The account method in which a more or less detailed study is made of exercises which are immediately arranged in the form of ledger accounts. After the effect on the accounts has been determined a series of transactions is journalized and posted to the ledger and a trial balance is made as before.

3. The statement or balance-sheet method, which begins with a statement of assets, liabilities, and capital. After the student understands the statement he proceeds to the accounts and then to the books of original entry, journalizing, posting, and taking a trial balance as in each of the other methods.

Although all three methods will arrive at the same place—namely, the trial balance—there is a difference of opinion as to the value of each method.

The method of each text is indicated in the list of textbooks.

The instructor should encourage the student to do good work at all times and be reasonably sure that the student understands each assignment before taking up the next. Avoid having the student commit to memory answers for review or quiz questions; let him answer in his own words. Overlook an occasional arithmetical error, but do not pass an error in principle. Detailed instructions for students will be found in the text and practice material. Topics of interest to the instructor relating to the teaching of bookkeeping are discussed in the following books:

1. R. B. Kester, *"Accounting, Theory and Practice,"* Vol. I., The Ronald Press, New York. \$3.
2. McFarland and Rossheim, *"A First Year in Bookkeeping and Accounting,"* D. Appleton & Co., New York. \$1.50.
3. Kahn and Klein, *"Principles and Methods in Commercial Education,"* The Macmillan Co., New York.

H. STANDARDS

If instruction is given by the journal or account method, the student should be able to record simple business transactions in journal form, transfer these to the ledger, and obtain a trial balance.

If the balance sheet or statement form of instruction is followed, the student should be able to prepare simple statements of assets, liabilities, and capital, schedules and inventories.

In the journal and account method rate according to the following:

1. Accuracy in selecting the proper debits and credits which apply to the various accounts involved in the business transactions, and classification of assets, liabilities and capital in preparing the financial statements.

2. Form in preparing accounts, journal entries, and statements.

3. Neatness in arranging the material in the various books and statements. The student should be neat even if his handwriting is poor.

4. Promptness in preparing and submitting assignments. It is realized that we are now dealing with men recovering from wounds and otherwise physically or mentally incapacitated; therefore promptness is placed last.

Regardless of the method employed, the grade of proficiency should be indicated by one of the following letters:

A—Excellent.

B—Good.

C—Passing.

D—Failure.

A SPECIMEN FINAL EXAMINATION FOR UNIT I

For students who have followed the journal or account method

Time allowed: 1½ hours.

Material required:

1 double sheet journal paper.

1 single sheet ledger paper.

Instructions:

Page the journal 1-2-3-4. Use pages 1-2-3 for recording the transactions in journal form and write the trial balance on page 4.

Page the ledger 1-2. Allow 15 lines for the "cash" account and 7 lines for each of the other accounts.

Use the following data:

1. Journalize, giving full explanations.
2. Post to the ledger.
3. Pencil foot the accounts.
4. Prepare a trial balance.

If the student has been using the journal sales book, purchase book, and cash book, or any combination of these, the instructor may direct such student to use the journal and one or more of the other books of original record instead of the journal only.

June 2, 1918—C. E. Rice began the wholesale furniture business at 534 Main Street and invested \$12,000—in cash.

June 2—Leased from the Eastern Real Estate Co. the store building at 534 Main Street for one year at \$1,800 and paid cash for two months' rent in advance to August 1.

June 6—Bought from Skinner & Co., for cash, office and display fixtures for use in the store, \$2,000.

June 9—Bought from Bliss & Stanton, on account, 30 days' invoice of furniture, \$6,000.

June 16—Sold to L. C. Smith, on account, 40 dressers at \$50 each; 20 refrigerators at \$40 each.

June 18—Paid cash for postage, \$5; stationery and other office supplies, \$30.

June 20—Sold to F. E. Duncan for cash 24 brass beds at \$50 each; 12 couches at \$90 each.

June 22—Bought from the Remington Typewriter Co., for \$100 in cash, one typewriter for use in the office.

Use the following data—Continued.

- June 23—F. E. Duncan returned two brass beds purchased on the 8th and we refunded the selling price, \$100. These beds were not the style ordered.
- June 24—C. E. Rice withdrew \$60 in cash for his personal use.
- June 25—Bought from R. H. Ferris, terms 30 days, invoice of furniture, \$2,000.
- June 30—Paid clerks' salaries in cash, \$100.
- June 30—Paid Bliss & Stanton \$4,500 in cash to apply on account.

Note to the instructor:

- Deduct 5% for each incorrect debit or credit item in the journal. Maximum deductions, 60%.
- Deduct 1% for each incorrect explanation in the journal. Maximum, 5%.
- Deduct 1% for each error in posting to the ledger—such as failing to postmark the item in the journal or to indicate the page of the journal in the ledger account, or entering on the wrong side in the ledger. Maximum, 5%.
- Deduct a total of 5% for failure to pencil-foot the accounts in the ledger.
- Deduct a total of 10% for failure to obtain a trial balance that balances.
- Deduct from 1 to 10% for incorrect form in journal, ledger, and trial balance.
- Deduct a total of 5% for careless work.
- If the sales book, purchase book, or cash book have been used in addition to the journal, deduct 5% for each incorrect debit or credit entry in any book of original entry. Maximum deduction, 60%.

INSTRUCTOR'S KEY OR SOLUTION TO PRECEDING EXAMINATION
Your City, June 2, 1918.

		C. E. Rice began the wholesale furniture business at 534 Main St. and invested \$12000 in cash.	12000	-		
1		Cash				
1		C. E. Rice, Capital			12000	---
		June 2				
1		Expense	300	-		
1		Cash			300	---
		Paid the Eastern Real Estate Co. cash for two months rent to Aug. 1 according to terms of lease.				
		June 6				
2		Furniture & Fixtures	2000	-		
1		Cash			2000	---
		Bot from Skinner & Co. inv. of office and display fixtures.				
		June 9				
2		Purchases	6000	-		
2		Bliss & Stanton			6000	---
		Bot from Bliss & Stanton n/30 inv. of furniture				
		June 16				
2		L. C. Smith	2800	-		
2		Sales			2800	---
		Sold to L. C. Smith on a/c 4 Dressers @ \$50. 20 Refrigerators @ \$40.	2000- 800- 2800-			

June 18, 1916.

1	Expense	35	-		
1	Cash			35	-
	Paid cash for postage \$5 and stationery and other office <u>supplies</u> \$30.				
	June 20				
1	Cash	2280	-		
2	Sales			2280	-
	Sold to F. E. Duncan for cash				
	24 Brass Beds @ \$50	1200-			
	12 Couches " \$90	<u>1080-</u>			
		2280			
	June 22				
2	Furniture & Fixtures	100	-		
1	Cash			100	-
	Bot from Remington Typewriter Co. for cash 1 typewriter				
	June 23				
2	Sales	100	-		
1	Cash			100	-
	P. E. Duncan returned 2 Brass Beds from sale of 6/20 because they were not the style ordered. We refunded \$100 in cash.				
	June 24				
1	C. E. Rice, Capital	60	-		
1	Cash			60	-
	M. Rice withdrew cash for personal use.				

June 25, 1918.

	2	Purchases	2000			
	2	R. H. Ferris			2000	-
		Bot from R. H. Ferris n/30 invoice of furniture				
		June 30				
	1	Expense	100	-		
	1	Cash			100	-
		Paid clerks salaries				
		June 30				
	2	Bliss & Stanton	4500	-		
	1	Cash			4500	-
		Paid Bliss & Stanton cash on account.				
		Trial Balance June 30, 1918.				
	1	C. E. Rice, Capital			11940	-
	1	Cash	7085	-		
	1	Expense	435	-		
	2	Furniture & Fixtures	2100	-		
	2	Purchases	8000	-		
	2	Bliss & Stanton			1500	
	2	L. C. Smith	2800	-		
	2	Sales			4980	-
	2	R. H. Ferris			2000	-
			20420	-	20420	-

C. E. Rice, Capital

1918 June	24	J 3	60	-	1918 June	2	J 1	12000	-
CASH									
1918 June	2	J 1	12000	-	1918 June	2	J 1	300	-
	20	J 2	2280	-		6	J 1	2000	-
						18	J 2	35	-
						22	J 2	100	-
						23	J 3	100	-
						24	J 3	60	-
						30	J 3	100	-
						30	J 4	4500	-
EXPENSE									
1918 June	2	J 1	300	-					
	18	J 2	35	-					
	30	J 3	100	-					

Furniture & Fixtures.

1918 June	6	J 1	2000	-					
	22	J 2	100	-					
PURCHASES									
1918 June	9	J 1	6000	-					
	25	J 3	2000	-					
BLISS & STANTON									
1918 June	30	J 4	4500	-	1918 June	9	J 1	6000	-
L. C. Smith									
1918 June	16	J 2	2800	-					
SALES									
1918 June	23	J 3	100	-	1918 June	16	J 2	2800	-
						20	J 2	2280	-
R. H. FERRIS									
					1918 June	25	J 3	2000	-

A SPECIMEN FINAL EXAMINATION FOR UNIT I

(Time, one hour)

This examination covers the ground represented by Goodyear's units 1 and 2 and Belding's Accounts and Accounting.

NOTE.—You were called in by Arthur Thomas, a retail dealer in furniture, to prepare a statement of the financial condition of his business as of December 31, 1918.

From data supplied by Mr. Thomas and through your own investigation you obtained the following information:

He owns a store building and lot valued at cost, \$15,000, subject to a mortgage of \$5,000. Cash in bank, \$978.50; in the safe and cash register, \$263.10. He owes creditors on account as follows: Bright & Nixon, \$372.40; Chicago Furniture Co., \$268.15; Grand Rapids Furniture Co., \$530.75; John Dennison, \$240. His delivery equipment, consisting of one motor truck purchased for \$900, is now estimated as having depreciated 30%. He owes for taxes an estimated amount of \$86. There is due him from customers as follows: Globe Hotel, \$120; Abram Cohen, \$62.40; Tom Jenkins, \$75; Frank Chatfield, \$37.65; Howard & Co., \$58.30. His store equipment and fixtures cost new \$1,784, and is now estimated to be worth 20% less than cost. He owes on notes given to his creditors, \$764.50, and there is due his clerks for salaries \$80. His inventory of merchandise (stock of furniture) shows at cost price \$4,272.35, on which we estimate a reduction of 5% for old stock. The following notes receivable are in his safe:

No.	Maker	Amount
1	H. F. Norris----	\$100
2	Chas. Read----	50
3	Wm. Baker----	80
4	L. Levine-----	75

Date	Time	With interest
Oct. 31, 1918	6 mos.	at 6 %
Nov. 25, 1918	5 mos.	at no %
Dec. 1, 1918	90 days	at 6 %
Nov. 15, 1918	4 mos.	at no %

Miscellaneous stationery, office supplies, etc., is estimated to be worth \$127. Oil, grease and gasoline for motor truck use has a value of \$28.

One year ago, December 31, 1917, Arthur Thomas' capital was \$12,000. During the year he withdrew \$500 in cash for his personal use.

From the foregoing prepare—

- (a) A balance sheet or financial statement.
- (b) Schedules of accounts receivable and accounts payable.
- (c) A statement showing the profit earned during the year.

Grade as follows:

Deduct 3% for each item in the balance sheet incorrectly entered or omitted; 5% for faulty heading and 10% for incorrect form.

Deduct 3% for each item incorrectly entered or omitted from the schedule of accounts receivable and accounts payable; and 5% for incorrect form of schedule.

Deduct 10% for incorrect statement of the profit earned.

INSTRUCTOR'S KEY TO PRECEDING EXAMINATION

Arthur Thomas

Balance Sheet - December 31, 1918.

<u>Assets</u>							
Cash in Bank \$978.50	Safe \$263	10	1241	60			
Notes receivable			305	-			
Interest accrued on Notes Rec.			1	40			
Accounts Receivable (Schedule A)			353	35			
Misc Stock (Less 5%)			4058	73			
Office Supplies			127	-			
Delivery Supplies			28	-			
Motor Truck	900	-					
Less Depreciation	270	-	650	-			
Furniture & Fixtures	1784	-					
Less Depreciation	356	80	1427	20			
Store Building & Lot			15000	-			
Total Assets					23172	28	
<u>Liabilities</u>							
Notes Payable			764	50			
Accounts Payable (Schedule B)			1411	30			
Taxes Payable			86	-			
Due to Clerks (or Salaries Payable)			80	-			
Mortgage Payable			5000	-			
Total Liabilities					7341	80	
Capital					15830	40	
Represented by							
Arthur Thomas' Capital a/c							

Rehabilitation monograph. Joint Series No. 38.

Unit Course—Painting and Decorating 1—Painting new walls and ceilings

PAINTING AND DECORATING

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This unit course is intended for the man with a common-school education who expects to follow the occupation of painting and decorating and who wishes to become something more than a mere "brush hand." The work outlined in this course does not necessarily require previous experience in this line of work.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

Upon completing this unit course the student should be able to do the following:

- (1) Appreciate the purpose of paint both as a protective and as a decorative agent.
- (2) Mix and apply oil paint to newly plastered walls and ceilings according to best modern usage and practice in this craft.
- (3) Secure employment as an "approver" in a painting shop, or with a contractor doing high-class work, or in any of the larger hotels, apartment houses or real estate concerns which regularly employ a force of painters and decorators.
- (4) Take additional unit courses which are provided in this subject, thereby increasing his skill and proficiency.

3. LENGTH OF THE COURSE

The time required to complete the work of this unit is estimated at about 30 hours, distributed as follows:

	Hours
(1) Covering floor and setting up scaffold.....	1
(2) Folding sandpaper and sandpapering ceiling and walls.....	1
(3) Plastering cracks and filling dentations.....	2
(4) Cleaning and dusting woodwork.....	1
(5) Breaking lead and mixing paint.....	1
(6) Tinting and straining.....	1
(7) Cleaning pots and making putty.....	2
(8) Applying first coat, brush work.....	4
(9) Applying second coat, including sandpapering, puttying and mixing paint.....	5
(10) Applying third coat, same as above.....	5
(11) Applying last coat, including mixing, straining, and stippling.....	6
(12) Cleaning and caring of brushes.....	1
Total.....	30

4. EQUIPMENT AND MATERIAL

Each student should provide himself with the following outfit: One small flat putty knife, one large flat putty knife, one small pointed trowel, one dusting brush, one old knife for cutting out cracks, old shoes or slippers, cap, and white overalls.

The following equipment is generally supplied by the contractor or employer and should therefore be supplied by the school offering this course (brushes required in plain painting): Flat wall brush, 4 to 6 inch, 6 to 8 inch; kalsomine brush; pound or oval brush; sash tool, 2-inch brush; flat brush, 2½-inch; fitch, 1-inch; stippler; Iron pails, No. 12, No. 14; Iron paint pots; cheese cloth straining; cheese cloth, rubbing; mixing tubs; pots for brushes; drop cloth (muslin), for protecting walls, floors, etc.; building paper, used for protecting floors; ladders; planks, 10 to 12 foot; planks, 4 to 6 foot; sponges; sandpaper, No. 1, No. 1½, No. 2; pail with cover for rubbish; cotton waste.

A supply of the following oil painting materials is required for this course: White lead; linseed oil (raw); turpentine; driers; tinting colors, ground in oil; putty.

5. MEASURING, RATING AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating such subjects as painting and decorating are available, it is recommended that final rating be recorded as follows: The average student will be rated good; the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in commercial practice should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just, and of value both

as a credential for the student and as record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

Ability to sandpaper and prepare ceiling and walls of all descriptions.

Ability to lay on paint in a thin even film.

Ability to putty holes between coats.

Ability to sandpaper walls between coats.

Ability to determine when wall is dry enough to apply the following coat.

Ability to handle brushes.

Ability to cut out cracks and plaster same.

Ability to touch up cracks with paint and shellac.

Ability to size ceiling and walls.

Personal care of hands and clothing.

Care of pots.

Care of materials.

Care taken in measuring ingredients for painting.

Care of brushes.

Care and use of drop cloths.

Care of oil rags.

Ability to make out report and compute cost of jobs.

The instructor should also determine the value of each student according to interest and ability shown.

6. OUTLINE OF LESSONS

The course consists of four problems, representing the four commonly used finishes of new walls and ceilings as follows:

Problem I.—Flat finish on walls and ceiling.

Problem II.—Semigloss finish on walls only.

Problem III.—Full gloss finish on walls and ceiling.

Problem IV.—Enameled gloss finish on walls and ceiling.

7. GENERAL SUGGESTIONS TO THE INSTRUCTOR

The trade of house painter is too often supposed to consist of manual processes only. It is thought by many that a young man has only to follow others in order to become a competent workman. However, a great change has taken place in this occupation, and it is now admitted that every effort should be made to give technical instruction, to teach the principles on which the practice is based, to interest the minds of students in the higher branches of the trade, and to show that the more the mind comprehends the requirements the better the hand will execute the work. The course presented herewith is intended to make the student something more than a mere "brush hand."

There is probably no trade that presents so many variable conditions for the consideration of the workingman as that of painting. No one rule can be given that will apply to every job. Treatment that will answer in one instance may be unsuited to another case. On some jobs conditions may be such that the treatment must be modified. Experience and a knowledge of materials must then determine the proper course to pursue.

The best method of teaching this subject is to provide a room with walls newly plastered upon which the students may work. A newly finished house, if available, is an ideal laboratory or workshop for the student's practice of this course. In order to master the principles involved in the problems presented and within the time allotted, each student should cover in each problem a minimum of 350 square feet of wall surface, at least one-fifth of which should be on the ceiling.

The instructor should explain to students how to study and interpret the student's instruction sheets; he should carefully demonstrate each step; then let the student follow with paint and brush. While the students are working, the instructor should be alert to see that the work is being properly done. Devote special attention to the laying on and careful brushing of paint.

A study of the directions in the student's instruction sheet will suggest to the instructor many points concerning the method of conducting the work.

Students should be taught to interpret the architect's specification for finishing the various rooms of a building, to estimate the cost of doing the work according to the specifications, and to write orders for the necessary materials. The instructor should insist upon the student filling out the record blank for each room or problem. This blank is relatively simple for this course, but in succeeding courses new features are added calculated to teach the student to figure such items as depreciation, interest, insurance, rent, fuel, and other items entering into "overhead" expense.

Each problem should be thoroughly mastered by the student before starting another. In the progress of the work students may be classified according to the proficiency shown, and each group advanced as rapidly as it deserves.

In this subject, neatness is of primary importance. The teacher should therefore impress upon the student the following points:

1. The workman should be careful of his personal neatness and cleanliness.
2. He should at all times keep all pots, pails, floor, and trim clean and systematically arranged.
3. He should be particular about the care of brushes, tools, putty knife, etc.
4. He should be cautioned concerning the danger of leaving oil rags around where they may cause fire by spontaneous combustion.

It will add much to the interest of this course if the instructor will collect and arrange an exhibit of various painting materials showing the crude product and the processes through which it passes to the finished substance. Much of this material can be secured by applying to the manufacturers of various lines of painting materials.

Suggestions for teaching Problem I.—Flat finish on walls and ceiling

Before starting students on brush work, it is advisable to have them thoroughly understand scaffold work—that is, the erecting of scaffolding in a room—showing how to spread and set up a ladder, the distance from wall, and firmness. Student is also to be shown how to carry a ladder properly, how to carry a plank, and the proper setting of planks on ladders.

Show how to tack up drop cloths so that tack holes will not show after drop cloths are removed; they should be tacked on top of moldings and in crevices of moldings or on trim where hole will show the least.

Explain the method of folding sandpaper.

Explain the process of wetting the plaster and how important it is not to mix too much at one time.

When breaking lead, show student about how much lead to take for a given surface and have him mix only the amount required for a coat of paint.

Before applying the second, third, or fourth coat instruct student in the method of passing the hand over the walls, so as to determine the tack; when one can pass hand over wall and paint has no tack, it is then hard enough to apply the additional coat.

In tinting colors, instruct students to thin tinting colors and add very slowly to white lead until they have color desired.

In applying the last coat, be sure before starting that you have enough students to finish one wall. Let two men apply the paint and two men stipple, keeping close to the students applying the paint.

Describe what will happen in regard to laps if stippling is not done rapidly.

Suggestions for teaching Problem II.—Semigloss finish on walls

Where the ceiling is kalsomined and the wall is about to be painted, instruct the students to remove all kalsomine spots by washing or sandpapering (washing is the best method). The same care should be taken as mentioned in Problem I.

Suggestions for teaching Problem III.—Full gloss finish on walls and ceilings

In this problem the same care should be taken as in Problem I, with the exception of applying the last coat. One man can go over a very large surface alone without any setting or laps showing.

Suggestions for teaching Problem IV.—Enameled gloss finish on walls and ceilings

Be sure to instruct students not to put too much oil in paint where enamel is to be applied; if undercoating is oily and not thoroughly dry, the enamel will crack in hardening.

In applying enamel there should be more than one man on a large surface, as this sets quickly and will run if not quickly brushed.

Instruct students as to the care of enamel, always covering enamel as soon as possible. By leaving enamel pot uncovered for any length of time it will gum and harden. Have men put just enough in a pot at once to use for about one-half hour at a time.

8. BOOKS FOR REFERENCE

Ellis A. Davidson—House Painting. Published by Modern Painter, Chicago. Price, \$2
 Alvah Horton Sabin—House Painting. Published by John Wiley & Sons, New York. Price, \$1.

Walter J. Pearce—Painting and Decorating. Published by J. B. Lippincott & Co., Philadelphia. Price, \$3.25.

LIST OF PROPOSED UNIT COURSES IN PAINTING AND DECORATING

	Hours
1. Painting new walls and ceilings ¹ -----	30
2. Kalsomining and whitewashing ¹ -----	30
3. Treatment of old walls and ceilings ¹ -----	30
4. Paper hanging-----	30
5. Treatment of new woodwork, including floors-----	30
6. Treatment of brickwork-----	15
7. Treatment of ironwork-----	15
8. Mixing colors-----	15
9. Design of ceilings and walls, including stencils, laying on, and edging ornaments-----	30
10. Furniture finishing-----	15
11. Furniture painting-----	15
12. Sign painting-----	30
13. Show-card writing-----	30
14. Scenic painting-----	30

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

1. GENERAL INSTRUCTION

1. Why is paint used?

A. Paint is applied either as a protective or a decorative agent, and sometimes as a combination of both. Its use is confined to no particular class of surface or material.

2. What is the purpose of the various applications of paint?

A. The application of paint, commonly termed as "coats," is necessary to insure a solid surface or appearance. The earlier coats are to render the work non-absorbent. The intermediate coats are to produce a level surface. The final coat is to give color and effect.

3. What care should be taken when applying paint?

A. The paint must be thin enough to spread with a brush and heavy enough to adhere to the surface without running. Apply each coat of paint with a thin even thickness of film.

¹ Already prepared.

4. What care should be taken before a second or an additional coat is applied upon a surface just painted?
 - A. Care must be taken to see that the paint applied becomes hard and adheres firmly to the surface on which it has been applied, so that it can be sandpapered and puttied upon filling all holes, dents, etc.
5. What grades of sandpaper should be used when sandpapering newly painted walls or ceilings?
 - A. No. 0, fine; No. $\frac{1}{2}$ ", medium; No. $1\frac{1}{2}$ ", coarse.
6. What is putty?
 - A. Common putty is made by grinding linseed oil and whiting. Lead putty is made with paste white lead and powdered lead, whiting, zinc, or litharge. Litharge helps to harden it quickly.
7. What rules for personal care should a painter observe?
 - A. Cleanliness: Hands should be kept clear of paint as much as possible. Clean the hands of all paint before eating. Never wash the hands with turpentine or benzine, because of the bad effect of these substances on the tissues of the skin and on the nervous system. The best material for washing the hands is good laundry soap and warm water.

Never drink water left uncovered in a paint shop, because the water will absorb considerable quantities of poisonous fumes from painting materials.

Always have clean overalls. Tidiness of dress will indicate your standards of neatness, which will be reflected in your work.
8. What are the general precautions that a painter should always observe?
 - A. Always have drop cloths or coverings on hand to protect trim, furniture, and floors where painting is to be done. Pots should be cleaned and carefully brushed down when finished.
9. What care should be taken of brushes?
 - A. Brushes should be cleaned and carefully put away; they can be set in oil or water (water is mostly used). Care should be taken that brushes are in straight and suspended by hooks or wires so that tips are kept from bottom of pot.

A kalsomine brush should be washed with water directly after using, then hung up by the handle to dry. Oil-paint brushes, after using in paint and if they are to be used again, can be left in a pot or pail filled up to the binding of the brush. They can be washed in turpentine, benzine, kerosene, or soap and water. Put them away in a closed box until further use is desired.
10. What should be done to a brush that has become hard?
 - A. Before using it should be cleansed with a prepared paint and varnish remover or with lukewarm kerosene, which can be made warm by putting some in a small can, then set in a pail of boiling water; have brush soak in this until soft. (Never attempt to warm kerosene over a fire.)

MAKING OUT REPORTS ON JOBS

At the close of each problem or job, make out and give to your instructor a written report, using the following form:

Painting and decorating—Unit course No. 1

Student's report on job

Name.....
 Address.....
 Room No.....
 Condition of surface.....
 Number of square feet.....
 Commenced (date).....
 Finished (date).....
 Charge for time:
 ----- hours at ----- per hour ----- \$

Charge for materials:

-----pounds white lead at-----	\$-----
-----gallons raw linseed oil at-----	-----
-----gallons turpentine at-----	-----
-----gallons drier at-----	-----
-----color (specify kind) at-----	-----
-----pounds putty at-----	-----
Add in the same manner all other material used-----	-----
Total-----	\$-----

PROBLEM ONE—FLAT FINISH ON WALLS AND CEILINGS

1. Specifications

Room No. 1

Ceiling and walls:

To be prepared and painted four coats, last coat to be flat finish and stippled. Samples of color to be submitted to owner.

NOTE.—This is an exact copy of a paragraph from an architect's set of specifications for a house.

2. Directions for work

1. Prepare the ceiling and walls:

First look for cracks. If any are found, fill same with plaster, then pass hand over plaster to see if there is any roughness. Give a light sandpapering with a 1½ grade of sandpaper, rubbing up and down.

2. Apply the priming coat:

After the wall is examined give it a priming coat (this is also called the first coat). Priming should be mixed rather thin, consisting of 80 per cent raw linseed oil, 20 per cent turpentine; about 1 per cent of drier is added, using about 10 to 12 pounds good grade of white lead to the gallon.

3. Apply the second coat:

When the first coat is thoroughly dry, give the wall another light sandpapering, using grade No. 1, or, if paint is hard, grade 1½ can be used. This is done to remove all grit and dust that may have settled on the painted surface. The second coat should have a little less oil and a little more turpentine and about the same amount of driers. The paint should consist of about 70 per cent oil, 30 per cent turpentine, 1 per cent driers, and about 15 pounds good-grade white lead.

4. Apply the third coat:

When the second coat is hard, which in fair drying weather should take about 48 hours, give another light sandpapering. The third coat should consist of 50 per cent oil, 50 per cent turpentine, less 1 per cent driers, and about 18 pounds of good-grade white lead. This coat should be tinted a shade darker than the final coat, as it gives the final coat a more solid appearance. This coat should also be very carefully brushed and laid on as evenly as possible. Where the undercoating has been carelessly applied, this coat is very often stippled.

5. Apply the fourth coat:

The fourth and last coat should, as in all painting, be applied when the undercoating is thoroughly dry. The last coat should be tinted the exact shade required. For a flat coat the paint should consist of 90 per cent of turpentine, 10 per cent of raw linseed oil, and no driers. It should be carefully applied and stippled. On a large ceiling and wall two men are required, as the edge is to be kept from setting and no stops allowed in applying paint and stipple; therefore this should be worked quickly.

6. Make out report on this job as explained in introduction.

Questions for study

1. How many coats of paint should a new plaster surface receive for a finished job?
A. Four to five coats.
2. What is meant by flat finishing?
A. Flat paint is a term used for a dull finish, no gloss. This coat is mixed almost entirely with turpentine.
3. What is an eggshell finish?
A. An eggshell finish is not entirely dull, has a slight gloss. This coat is mixed about 80 per cent turpentine, 20 per cent oil, or sometimes 50 per cent oil and 50 per cent turpentine.
4. Explain what is meant by a paint gloss finish?
A. This coat stands out with a shine; it is mixed almost entirely with oil; very little turpentine is used in this coat.

PROBLEM TWO—SEMIGLOSS FINISH

1. *Specification*

Room No. 2

Walls:

To be prepared and painted three coats, last coat to be semigloss finish and stippled.

2. *Directions for work*

1. Prepare the walls:
After ceiling is kalsomined, walls are sandpapered. Where the walls are to receive only three coats of paint, they should be carefully examined. If the plaster surface is not thoroughly hard and walls have a suction, they should be sized with a glue size the same as for papering. A thin coat of varnish is sometimes used before first or priming coat is applied.
2. Apply the coats in order, as in problem 1.
3. The quantity of oil, turpentine, and drier in each coat for a three-coat semigloss finish is as follows:
First coat, 80 per cent oil, 20 per cent turpentine, 1 per cent drier.
Second coat, 60 per cent oil, 40 per cent turpentine, 1 per cent drier.
Third and last coat, 70 per cent turpentine, 30 per cent oil, less than 1 per cent drier. (Last coat should have a little more lead in paint than first or second coat.)
4. Make out report on this job.

PROBLEM THREE—FULL GLOSS FINISH ON WALLS AND CEILING

1. *Specification*

Room No. 3

Ceiling and walls:

To be prepared and painted three coats; oil paint carefully brushed; gloss finish.

2. *Directions for work*

1. Prepare the wall surface as in problem 2.
2. Apply first coat as in problem 2.
3. For second coat, use 70 per cent turpentine, 30 per cent oil, 1 per cent drier.
4. The third coat should have 90 per cent oil, 10 per cent turpentine, 1½ per cent drier, and should not contain more than about 17 pounds of white lead to the gallon. This kind of painting is mostly done in kitchens, pantrys, closets, and bathrooms. The mixture given above is very durable and will outwear paint in which more turpentine is added. One man can paint over a large surface without showing laps. Paint should be carefully brushed so as to prevent runs.
5. Make out a report on this job.

PROBLEM FOUR—ENAMELED GLOSS FINISH ON WALLS AND CEILINGS

1. Specification

Room No. 4

Ceiling and walls:

To be prepared and painted three coats, and enameled two coats, gloss finish.

2. Directions for work

1. Prepare the walls as in previous problems.
2. Apply priming coat with paint mixed with 90 per cent oil, 10 per cent turpentine, 1½ per cent drier added.
3. The second coat is to be mixed with 60 per cent oil, 40 per cent turpentine, and 1 per cent drier added.
4. The third coat is to be mixed with 90 per cent turpentine, 10 per cent oil, no drier, and carefully applied.
5. The fourth coat is the first coat of enamel. Enamel comes already prepared. If it needs thinning, a little turpentine should be used; sometimes copal or dammar varnish is added. It should not be applied on paint until paint is bone dry. This is very hard to apply on a large surface and should be carefully brushed.
6. For the second coat of enamel the same care should be taken as with the first coat. It should be used as pure as possible. Bathrooms, sick rooms, hospitals, and sometimes kitchens are treated this way.
7. Make out a report on this job.

 Rehabilitation monograph—Joint Series No. 39.

Unit Course—Drafting 1—Elementary Machine Drawing

DRAFTING

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. DESCRIPTION OF QUALIFICATIONS OF STUDENTS FOR WHOM THE COURSE IS INTENDED

This course as outlined covers the elementary steps in mechanical drawing and pertains to the detailing of simple machine parts or simple shop tools. It is intended to be of particular value to the machinist, patternmaker, toolmaker, blacksmith, foundry man, structural ironworker, or mechanic in any trade where mechanical drawings are used. This unit course presupposes no previous knowledge of drawing, and is so planned that it may be taken by any individual, whether he has had previous shop experience or not, provided he has sufficient general education to read and understand the lesson sheets.

2. ATTAINMENT OR ADVANTAGE EXPECTED TO BE DERIVED BY THE STUDENT

It is expected that a student finishing this course will be able to make a detailed drawing of a simple machine part.

The following details of construction are covered: (1) The determining of the number of views required; (2) the selection of the proper views; (3) an understanding of the way to place views on a sheet; (4) what full lines on a drawing indicate; (5) what dotted lines indicate; (6) the information necessary for the intelligent use of angles; (7) use of the instruments; (8) the relative location of three views (which is the all-important step in this elementary study); (9) when a full section is required; (10) when partial sections will suffice; (11) the use of a scale drawing.

3. APPROXIMATE TIME REQUIRED TO COMPLETE THIS UNIT COURSE

This course should be completed in 24 hours. This can be made possible by varying the individual problems so that the 10 steps may be covered in the allotted time. One problem should be required in each step. To make this possible, a large number of problems for each step should be on file, and these problems should vary so as to be more or less difficult to execute, according to the varying ability of students.

4. EQUIPMENT AND MATERIALS

The lists given below are intended to cover the requirement for one student for completing this course:

- One drawing board, 18 by 24 inches.
- One T-square, 24 inches.
- One 45° triangle, 6 inches, celluloid.
- One 30°-60° triangle, 9 inches.
- One scale, 12 inches ($\frac{1}{16}$ and $\frac{1}{32}$ inch divisions).
- (Use of triangular scale is not recommended for this course.)
- One set of instruments, to include:
 - Large compass, with pencil and pen attachments.
 - Large dividers.
 - Bow pen.
 - Bow dividers.
 - Bow pencil.
 - Ruling pen.
- One drawing pencil (2H).
- One pencil eraser.
- Thumb tacks.
- Twelve sheets drawing paper, 11 by 16 inches, buff or cream.

NOTE.—The sets of instruments specified are intended to be used also for later unit courses. The inking pens will not be needed for this course.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating drawing work are available, it is recommended that final rating be recorded as follows: The average student will be rated good, the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in the commercial shop should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

(a) Time.—Is the student rapid, moderate, or slow in executing his work?

(b) Technique.—

Does the student use workmanlike methods?

Does he exercise reasonable economy in use of materials?

Is he neat and orderly in care of tools?

(2) Finished product:

(a) Accuracy.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.

(b) Quality.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.

(c) Mastery of principles.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

(a) Attitude toward work—

Does the student love his work or does he watch the clock?

Is he likely to continue in this line of work?

(b) Studiousness—

Does the student show disposition to study the printed literature related to this work?

Does he express a desire to take advanced unit courses in this or related subjects?

(c) Possibilities of growth.—Is the student likely in due time to receive promotion to positions of greater responsibility?

(4) Test problem:

A test problem might be given at the conclusion of the course which would involve all or most of the 10 points covered by the course. This should be presented in specification form, thus:

Make a complete working drawing of a webbed pulley 6 inches in diameter having a $\frac{3}{16}$ -inch rim; face $1\frac{1}{4}$ inches; web thickness one-quarter the width of the face; revolves on a $\frac{3}{4}$ -inch shaft; the diameter of the hub to be one and seven-eighths times the diameter of the reamed hole; the length of hole to be of the same dimension as the width of the face; drawing to be full size on a (B) sheet if a mechanical drawing is made or half size on an (A) sheet if a sketch is required. Use $\frac{1}{8}$ -inch fillets.

6. POSSIBILITIES AND ADAPTABILITY OF THIS COURSE

The outline of type problems presented are for those interested in machine-shop practice. It is possible by changing the problems, but adhering to this scheme of the outline, to present work which will appeal to the architect, carpenter, mason, etc. Elementary problems which would cover the first step in the outline for each of the above would be, for example, the drawing of a sill, a fishplate, or a stone post cap. These problems involve simply straight, full lines in the mechanical drawing. All the general instruction would apply to such courses in the same manner as applied to the machine course. In other words, the principles of elementary drawing may be applied to any branch of mechanical work.

7. OUTLINE OF LESSONS

	Hours
Lettering.....	2
(1) Straight full-line problems.....	2
(2) Dotted straight lines.....	1
(3) Introduce angular work—45° angle first.....	1
(4) Lines at 30° and 60°.....	2
(5) Triangles in combination to obtain 15° and 75°.....	2
(6) Circles.....	2
(7) Review of views.....	3
(8) Full sections.....	3
(9) Partial sections.....	3
(10) Scale drawings.....	3
	24

8. SUGGESTED ADDITIONAL PROBLEMS

Full-line problems—(1) step block; (2) parallel strip.

Dotted-line problems—(1) planer angle (with tongue); (2) anchor plate.

Forty-five-degree angle problems—(1) V-blocks; (2) chuck jaw blank (three-jaw chuck).

Thirty and sixty degree problems—(1) tool-post slide; (2) gib.

Fifteen and seventy-five degree problems—(1) planer V-block; (2) centering vise jaw.

Circular work—(1) link (common); (2) pillow block.

Review of views—(1) valve (steam); (2) bushing.

Sections—(1) steam piston; (2) cylinder head.

Partial sections—(1) globe valve body; (2) screw-jack base.

Scale drawings—(1) arbor (milling machine); (2) arbor base.

9. SUGGESTIONS FOR CONDUCTING THE WORK

There are two ways by which the problem may be presented:

(1) Through the medium of models. Whereas this method may create interest on the part of the student, in that he has something tangible to handle and look at, it does not develop the power to visualize the object before starting the drawing. This power of visualizing is of great importance to the draftsman, as the draftsman or machinist does not have the completed object to work from as a rule, except in the case of repair work, where a drawing of a part which has been worn or broken may be required.

(2) Through the medium of an isometric or perspective sketch. This method is considered by some teachers to be more satisfactory. This presentation lends itself to four possible classes of instruction: (a) The dimensioned perspective; (b) dimensioned perspective with a photograph showing the part in an actual set-up on the machine; (c) dimensioned perspective with the mechanical drawing partially completed; (d) perspective not dimensioned, with specifications giving dimensions and other information, if any, which are necessary. The above suggestions may also be combined. Class (a) in the above would be the type of problem given to those who have had previous shop experience and who will understand where the part may be used; class (b) is for those who are not familiar with shop set-ups and shop operations; class (c) is for those experienced in shop work, but with less ability than those who would follow class (a) work; class (d) is for students having had shop experience and with greater ability than those following class (a) work.

All students' instruction sheets are written for the type (a) problem. On some of them will be found specifications also. Specimen instruction sheets for types (b), (c), and (d) problems are shown on pages 13, 14, and 15.

10. REFERENCES USED IN THIS TEXT

All references to the work outlined are made to *Engineering Drawing*, by Thomas E. French, published by McGraw-Hill Book Co., 239 West Thirty-ninth Street, New York City.

In chapter 15 of this book is given a list of books on mechanical drawing, some of which will be of further aid to those teaching the course outlined.

Problems to be presented may be taken from a wealth of problems given in *Working Drawings*, by A. B. Babbitt, published by Henry Holt & Co., New York.

11. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets comprising part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

GENERAL INSTRUCTIONS

To mount paper on the drawing board, line up the upper edge of paper with upper edge of the square. Put tacks in two upper corners of the paper only. The paper will be securely held and the T-square will not hit against tacks when working on the lower part of the paper. This prevents nicking the T-square and adds to the convenience of the students.

Draw the margin. Make light lines. A light line in this case means a line which is just visible. Use this type of line throughout the work until the job is completed and checked. After the work has been accepted go over the full lines of the drawing and the marginal lines and make them a little darker, not heavier, thus making a contrast which adds to the technique of the drawing.

Order of steps in completing any drawing:

(1) Determine the number of views to be made of an object. If the object is rectangular in general form three views are required. If cylindrical in general form, two views.

(2) Select the views which will give the largest number of full lines and the fewest dotted lines.

(3) Determine the over-all dimensions of the object and draw rectangles inside of which the views are to be placed, as shown in Figure 1.

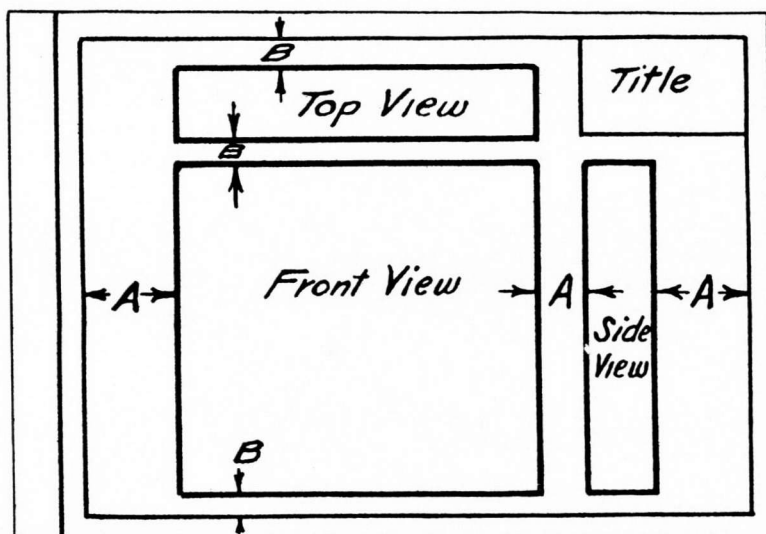


Fig. 1

NOTE.—The three dimensions (A) may all be equal if less than 1 inch. If in making them equal each would be more than 1 inch, do not have equal dimensions, but have the space between views 1 inch and the other two dimensions equal to one another. The foregoing explanation applies to the dimensions (B). Simply substitute (B) for (A) in the first sentence and apply.

(4) Complete the drawing.

(5) Dimension the detail. Consult *Engineering Drawing*, by French, pages 150–152.

(6) Letter title space.

(7) Have drawing approved.

(8) Intensify full lines of drawing and marginal lines.

All rules stated above are general; exceptions are to be made only when directed.

Never measure the drawings on the instruction sheets. The cuts are not made to scale.

Work from dimensions given.

Use a light line, not a black line, throughout the preliminary construction of the problem.

Intensify in step (8) refers to a line a little darker than the line used in the preliminary construction. Never resort to a black line.

LESSON ON LETTERING

Both capitals and lower-case letters are to be used. In the title space all capitals are to be three-sixteenths of an inch high, and all lower-case letters one-eighth of an inch high. Construction of letters is based on the ellipse and the straight line. The major axis of ellipse

is to slant at an angle of 60° with the horizontal. Guide lines about one-quarter of an inch apart will aid in keeping the proper slant. Guide lines should also be used in maintaining the required height of the letter.

Lay out an "A" sheet as shown on preceding page. Practice seven lines of capitals, seven lines of lower-case letters, seven lines of figures.

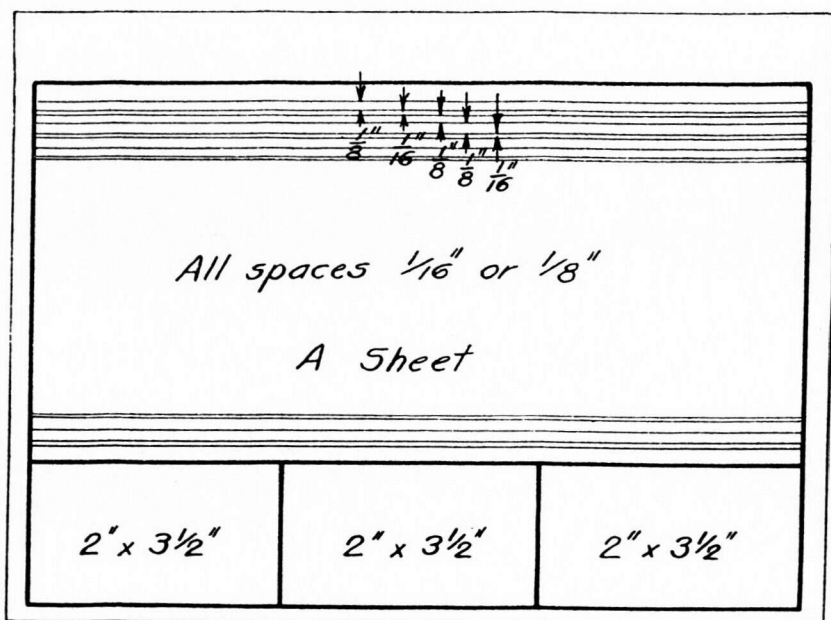


Fig. 2

Quality, not quantity, is preferred. Refer to the alphabet submitted before forming a letter, thus making relatively few letters correctly rather than repeating the same mistakes throughout the sheet.

Ellipses should be formed first and straight lines added to form the different letters of the lower case. The illustration (fig. 3) indicates the result desired as to spacing between letters of the same word and spacing between words.

SUGGESTED AIDS IN FORMING GOOD LETTERING PROPERLY SPACED

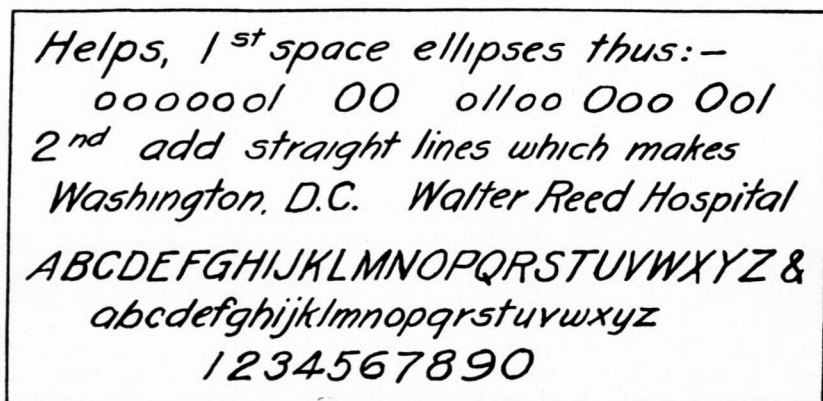


Fig. 3.

The suggested title space (fig. 4) will need to be changed only as regards the third and fourth lines.

SUGGESTED TITLE SPACE

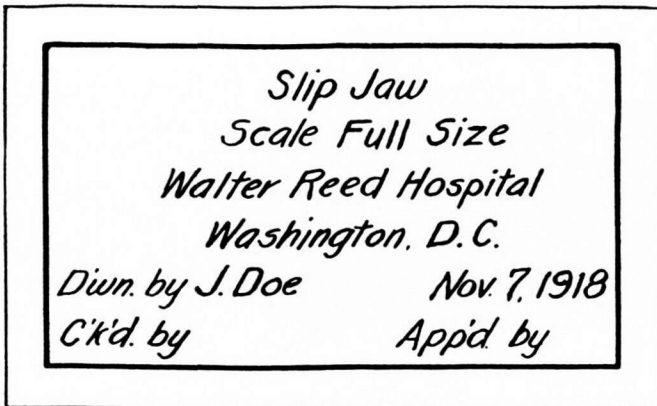
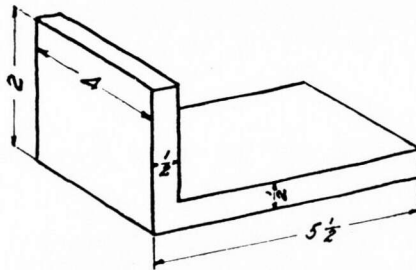


Fig. 4

LESSON I.—ANGLE IRON



2. Reference

Use of T-square and triangles explained for mechanical drawing students.
Engineering Drawing, by French, page 25.

Rules of projection. *Engineering Drawing*, by French, pages 65-72.

3. Definitions and facts

A vertical line runs up and down.

A horizontal line runs from left to right.

Full lines represent visible edges of the object.

4. Specification

A working drawing of three views is required of the angle iron, the over-all dimensions of which are $5\frac{1}{2}$ by 4 by 2. Stock is one-half inch thick.

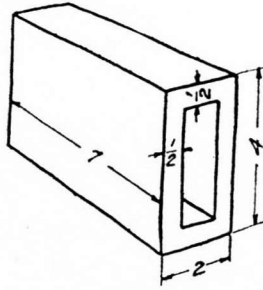
Use a (B) sheet for the drawing.

Drawing to be full size.

Application of the part to shop work

The angle iron is used to mount machine parts upon so that faces of such parts may be machined on the shaper, planer, milling machine, etc. It may also be used in combination with the face plate of a lathe where a boring operation is to be performed on a piece bolted to the face plate. The angle iron may also be used to hold a piece on which layouts for holes to be drilled are to be made.

LESSON II.—HOLLOW PARALLEL



1. Application of the part to machine work

A parallel of this type is generally used on the table of a planer and supports work which requires a planing or finishing operation.

2. Reference

No addition reference reading is necessary.

3. Definitions and facts

A dotted line as used in detail drawing is not what the name would naturally indicate. It is in reality a series of dashes each about one-eighth inch long and separated by a one-sixteenth-inch space. Such lines represent invisible edges of the object.

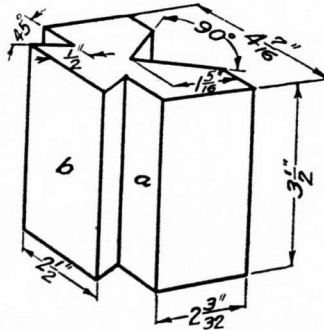
4. Specifications

The over-all dimensions of the hollow parallel are 7 by 4 by 2 inches. The stock is one-half inch thick.

Use a (B) sheet for the drawing.

The drawing to be full size.

LESSON III.—SLIP JAW



1. Application of the part to machine work

The slip jaw fits the dovetail slot of the movable jaw of a two-jaw chuck. Cuts may be made in the face of the slip jaw which will fit any irregularly shaped casting. The cut being a V shape in the jaw to be drawn indicates that jaws of this type are to be used in holding round stock where a lathe operation is required on the end of the stock.

2. Reference

Use of 45° angles explained for mechanical drawing students—*Engineering Drawing*, page 30.

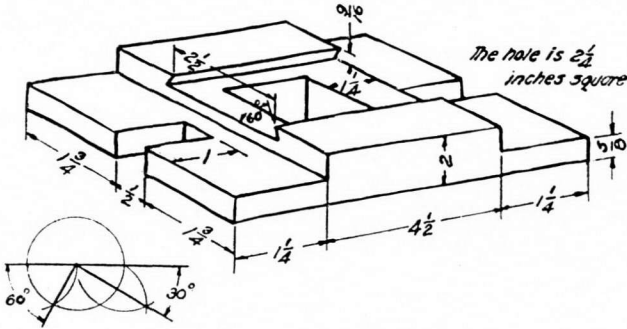
3. Definitions and facts

- (1) An angle is a figure formed by two straight lines which meet at a point called the vertex.
- (2) A circumference is the boundry line of a circle and all points on it are equidistant from a point within called the center.
- (3) A radius is a straight line drawn from the center to the circumference.
- (4) The degree is the unit of measure of an angle.
- (5) An angle of 1° is the figure formed by drawing two radii which intercept an arc one three hundred and sixtieth of the circumference.
- (6) A degree of arc is one three hundred and sixtieth of the circumference of a circle.
- (7) The degrees in the three angles of any triangle equal 180.

4. Specifications

No special specifications needed for this job.

LESSON IV—BOLSTER



1. Application of the part to machine work

The bolster is a holder for the die and is securely bolted to the casting of the press. Construction of 30° and 60° angles for sketching shown by figure.

2. Reference

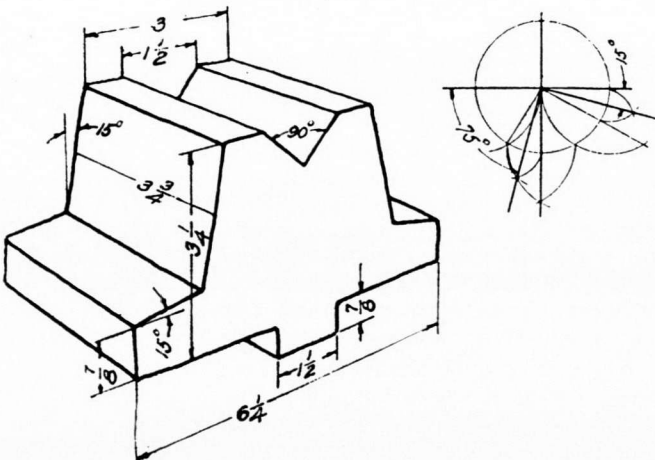
Use of 30° and 60° angles explained. *Engineering Drawing*, page 30.

3. Specifications

Use a (B) sheet for the drawing.

Scale to be full size on the drawing.

LESSON V—PLANE V BLOCK



1. Application of the part to shop work

The planer parallel shown above is strapped to the table of the planer and supports cylindrical work upon which a machining operation is to be performed.

Construction of 15° and 75° angles for sketching shown by figure.

2. Reference

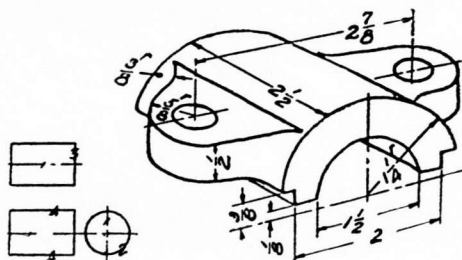
Use of 15° and 75° angles. See *Engineering Drawing*, page 30.

3. Specifications

Use a (B) sheet for the drawing.

Scale full size for the drawing.

LESSON VI—BEARING CAP



1. Application of the part to shop tools

The bearing cap is the simplest type of bearing cap, being made of cast iron and having no babbitt. Such a bearing is a very good type, but transverse wear can only be taken care of by renewing the part.

2. Reference

Use of compass. See *Engineering Drawing*, pages 31–34.

3. Definitions and facts

Center lines are placed vertically and horizontally through the center of circles and along the axis of cylinders. These lines are made up of a series of alternating $\frac{1}{2}$ -inch and $\frac{1}{8}$ -inch dashes with a $\frac{1}{16}$ -inch space between all dashes.

A line perpendicular to the plane of a circle which travels around the circle generates the lateral surface of a cylinder; such a line is an element of the cylinder.

The axis of a cylinder is an imaginary line passing through the center and parallel with the elements.

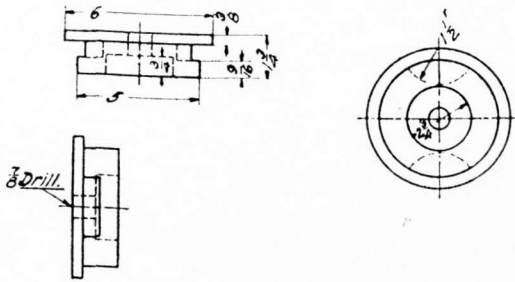
4. Specifications

After the rectangles have been located on the sheet, inside of which the views are to be placed, the center lines should be located as the next step in the development of the problems. Circles should be drawn next. Transferring of the diameter to the view requiring such a transfer should be the next operation; projecting from the circle the next. The numbers on the figure above indicate this order. Such a sequence of steps avoids the necessity of resetting the compass or dividers, which eliminates the possibility of error and saves time. Under ordinary conditions square corners in cast iron are not allowed; they are filled in; thus the term "fillet." Sizes of fillets are usually given in terms of the radius used in constructing them; thus $\frac{1}{4}$ -inch fillet.

Use a (B) sheet for drawing.

Scale full size on drawing.

LESSON VII—VISE BASE



1. Application of the part to shop tools

The detail shows a vise base. The vise, of which this base is a part, is usually referred to as a swivel vise because the jaws, clamping the piece upon which a machining operation is to be performed, may be twined upon the base which is secured to the machine. Such a vise is essentially a milling-machine vise.

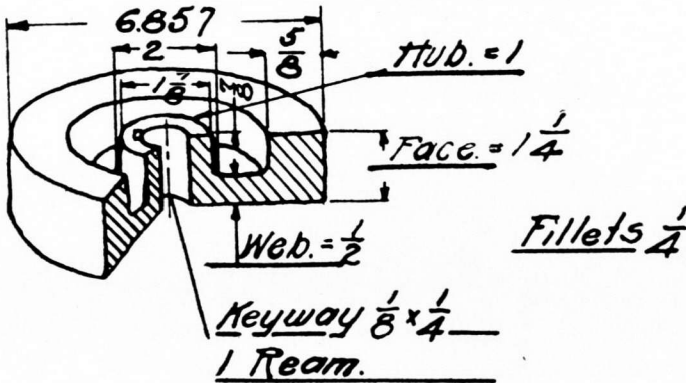
2. References

Review the work on projection in *Engineering Drawing*, pages 65–68.

3. Specifications

The three views as shown are complete, but the relative location is not correct. Complete a detail drawing properly placing the views.

LESSON VIII—GEAR BLANK



1. References

Engineering drawing—Symbols for materials in section, page 175.
Sectional Views, pages 77–81.

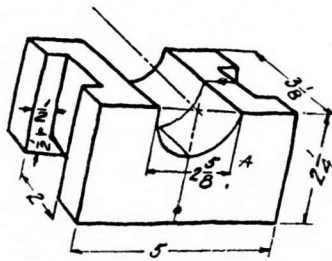
2. Definitions and facts

A drawing made by the use of full lines only is most easily made and most easily read. In order that an object with cored parts may be shown by a drawing, which requires only full lines in the construction, part must be imagined as cut away, exposing to view the inside. The surface made by passing the imaginary cutting plane through the object is covered by "section lines." These lines for cast iron are drawn at an angle of 45° about one-sixteenth inch apart and are full lines. Show no dotted lines in the sectional view.

3. Specifications

The outside diameter of the cast-iron gear blank is to be 6.857 inches; face, $1\frac{1}{4}$ inches; run, $\frac{5}{8}$ inch thick. Hub is $1\frac{7}{8}$ times the diameter of the reamed hole at the outer end and 2 times the diameter of the reamed hole at the web. The hub projects $\frac{7}{8}$ inch from the web. The web is $\frac{1}{2}$ inch thick; fillets $\frac{1}{4}$ inch radius. Gear is keyed with a $\frac{1}{4}$ -inch square key to a 1-inch shaft.

LESSON IX—BEARING BOX



1. Application of the part to shop tools

This type of bearing box is made of bronze and is used on the end of connecting rods.

2. Reference

Sectional views—*Engineering Drawing*, by French, page 175.

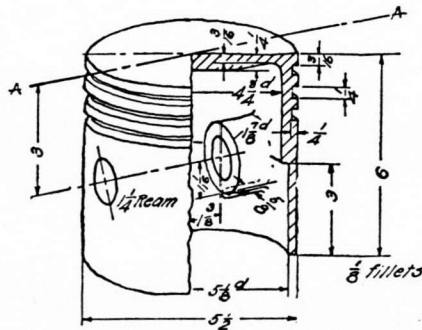
3. Definitions and facts

A partial section is sometimes made, instead of a full section, when the piece is symmetrical each side of a center line. This eliminates repetition on the part of the draftsman, thus saving time. Such a drawing makes the object more understandable as the outside and inside of the object is shown by the same drawing.

4. Specifications

The bearing box measures 5 by $2\frac{1}{4}$ by $3\frac{1}{8}$ over all. Grooves are 2 by $1\frac{1}{2}$. Diameter of the bearing $2\frac{5}{8}$ inches. Imaginary cutting plane passes along lines (a) and (b), thus removing the quarter (A).

LESSON X—GAS ENGINE PISTON



1. Definitions and facts

The details of a machine part are sometimes of such a size that a large sheet of paper would be required if the full-size drawing was to be made. It is at times possible to make the drawing smaller and not have the elements of the drawing too small to be easily read. When such is the case, the drawing is made "to scale," the parts being three-fourths, one-half, or one-fourth the actual size. The dimensions put on this type of drawing are for the full size of the object.

2. Specifications

The drawing required is to be made three-fourths size. A full section is required in one of the views. The cutting plane passing along line (A) (A). There are two bosses, only one being shown in the perspective, and the distance between their faces is $2\frac{3}{4}$ inches.

Rehabilitation monograph. Joint Series No. 40.

Unit Course—Woodworking 1—The Steel Square and Its Uses In House Framing

WOODWORKING

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the man who has had some experience in carpentry or has completed a course in joinery or woodworking. The ability to measure and to scale is essential. A knowledge of square root, geometry, and drawing, while not necessary, will prove valuable.

2. THE AIMS OF THE COURSE ARE—

1. To familiarize the student with the markings on the square and how to use them to advantage.
2. To give practice with the square in the many problems involved in framing.
3. To give the ordinary apprentice or woodworker the knowledge necessary for him to become a leading man, foreman, or builder.
4. To create an interest in the use of the steel square so that the student will delve deeper into its possibilities.

3. LENGTH OF COURSE

This course is intended to cover about thirty hours of instruction, study, and practice. In order to bring the course within the specified time the instructor will make necessary modifications and substitutions in the problems.

4. OUTLINE OF LESSONS

The following problems, common to house framing, are suggested for this course. The instructor is at liberty, however, to modify the problems or substitute others according to conditions and ability of students.

- | | |
|---------------------------|---------------------------------|
| 1. Steel Square Markings. | 6. Hip Rafters (equal pitch). |
| 2. Bridging. | 7. Hip Rafters (unequal pitch). |
| 3. Stair Strings. | 8. Valley Rafters. |
| 4. Polygons. | 9. Jack Rafters. |
| 5. Common Rafters. | |

5. SUGGESTIONS TO TEACHERS

1. Make a list of the operations involved in each lesson and give the class a demonstration of each.
2. Give as much individual instruction as possible, but do not do any work for the student.
3. See that each student studies at least two references given in each lesson.
4. Examine tools frequently to see if they are in good condition.
5. Demonstrate proper position for sawing, especially cutting jack-rafter bevels. Observe students carefully to see that instructions are understood and followed.
6. It is suggested that material for roof-framing problem be cut by machine so as to save as much time as possible. The sizes listed in lessons will be found to be most convenient.
7. At the end of the course a few full-size rafters should be cut and set up, involving hips, jacks, irregular pitch, etc.
8. A test may be given at the end of course by having students frame an octagon or hexagon hip roof, using frames constructed in Lesson 2.
9. It is suggested that the figures on the roof plan plate be followed, but, if necessary, the size may be increased or decreased according to the available room and material on hand.

10. All hip and valley rafters should be laid out, cut, and nailed in place. It is not necessary to fill in all of the jacks unless time permits. Have student cut at least two of each kind and nail in place. Frequently question student as to the source of the figures he is using for various cuts.

11. It is suggested that the students work in teams or pairs when framing the roof.

12. Several sets of house plans should be on hand and used in demonstrations.

SUGGESTIONS FOR TEACHING LESSON 1

1. Explain blade, tongue, heel, front of square usually stamped with manufacturer's name, kinds of squares, etc.

2. Discuss advantages and disadvantages of ordinary framing square and the take-down square.

3. Explain board foot and if a lumberman's log stick is to be had show its use and compare with the Essex Board Measure.

4. Discuss the value of the octagon scale in rounding a tapering square pole, such as a ship mast or spar.

5. Show how the last set of figures 18, 24, 30 on the brace measure may be used to square the lines of a building.

6. Have the students find the board feet in several pieces of lumber about the shop and check the results.

7. Practice in using the octagon scale may be had by drawing squares on cardboard or paper and then laying out octagon.

8. Show how the twelfths graduations on the square may be used to represent inches and each inch to represent a foot when working to a scale of one inch to one foot.

9. Some squares have the diagonal scale; explain to the class its use and how one may be constructed.

10. The total time spent on this lesson should not be more than two and one-half hours.

SUGGESTIONS FOR TEACHING LESSON 2

1. Explain the necessity of cross bridging, herringbone, etc. The building code, City of New York, requires one row of cross bridging every 7 feet.

2. It is suggested that a full-sized blackboard or paper drawing be made showing the end view of two 2"x10" floor joists spaced 16" on centers and the stock for bridging and the steel square shown in position for marking. This will show reason for applying figures to opposite sides of material.

3. If any boxes are available let the sides represent floor joists and have student cut bridging to fit.

4. Total time spent on this lesson should not be more than two hours.

SUGGESTIONS FOR TEACHING LESSON 3

1. Explain rise and run of a stairway, riser and tread, string.

2. To be properly proportioned the product of tread and riser should be between 60 and 66. Thus 5" rise, 12" tread; 8" rise, 8" tread.

3. Explain housed and open string and how each kind is laid out.

4. Show by blackboard sketch how a string piece for outside porch steps would be laid out and supported.

5. If a step ladder is needed about shop or grounds have a student construct one. It is not the intention, though, that the work in this lesson should go beyond the laying out of the strings. Figures other than those given in the lesson may be used by the instructor so as to make the problems individual.

6. Total time spent on this lesson should not be more than two hours.

SUGGESTIONS FOR TEACHING LESSON 4

1. Show how the size of the various angles in any regular polygon may be found by breaking the polygon up into triangles. For example, a hexagon consists of six equilateral triangles, an octagon eight isosceles triangles. Show how the angles may be computed.

2. Show how 12" on blade and 7" (approximately) on tongue of square can be used to lay out angles of 30 and 60 degrees. Likewise 12" and 5" or 17" and 7" for angle of $67\frac{1}{2}$ degrees, miter of octagon.

3. Explain that when the corners of an octagon are lapped, such as the sills and plates of an octagon bay window, the end cuts on the timber will be 45 degrees.

4. If the student does not proportion, explain Question 9. Question 10 also deals with proportion—namely, the distance between sides of an octagon is to the length on one side as 12 : 5.

5. It is suggested that half of the corners be mitered and half lapped in the lesson. This will be good practice, but need not necessarily be followed.

6. An ambitious student might construct a few other polygons besides those mentioned in the lesson, using the following figures: 7" and 4" for triangle; 11" and 4" for pentagon; $12\frac{1}{2}$ " and 6" for heptagon; $22\frac{1}{2}$ " and 9" for nonagon and $9\frac{1}{2}$ " and 3" for decagon.

7. Time spent on this lesson should not be more than three hours.

SUGGESTIONS FOR TEACHING LESSON 5

1. Explain to class pitch, rise, run, ridge, plate, eaves, plumb, and level cuts, birds' mouth notch, framing line, camber.

2. Give demonstration in use of rafter table if a square is to be had containing same.

3. Give a blackboard talk explaining the different styles of roofs. Blocks cut and shaped in the various roof styles will be found helpful.

4. Show how a rafter is marked out when it does not run over plate but has its upper edge meeting outer corner of plate. Show also how one is marked out when it extends over plate to support or form cornice. Also the treatment when false rafters are used for cornice.

5. Explain open and closed (boxed) cornices.

6. Give a short talk on the different kinds of rafters and if time permits construct a hip and valley roof from cardboard and explain the source of the figures used to obtain the various cuts and bevels.

7. Explain what to do when there is a fraction of a foot in the total run of the rafter.

8. Explain the use of the plumb bob when setting up ridge, hip, valley, or common rafters.

9. Time consumed on this lesson should not be more than four hours.

SUGGESTIONS FOR TEACHING LESSON 6

1. Explain construction of plate, lapping corners and bracing. Show how to square by testing diagonals. This is important, as it is almost impossible to frame a roof correctly on a plate which is out of square.

2. Explain the term on cotters and why rafters are not usually spaced the same as joists or studding.

3. Show use of collar beams and how to find cuts for same.

4. Show how ridge board is laid out to correspond with plate.

5. Explain the term backing, its use and why it is not necessary in small frame buildings.

6. Explain why deduction at upper end of rafter for one-half the thickness of ridge board must be measured square back from plumb line; on hip or valley, the diagonal distance of one-half thickness.

7. Explain that when a hip or valley is marked out the length found is the length of the center line on upper edge, and when bevel is marked this must be remembered and beveled line must pass through end of center line.

8. Explain source of figures which give bevel at top of rafter. Here is an old rule many carpenters use: Half width of building on tongue, length of common rafter on blade, blade gives cut. Instead of saying half width of building, the term run of common rafter could be substituted.

9. Show how the heel of a hip rafter must be laid out so that corners of such a rafter will be in line with the other common rafters of the roof. If framing line is used on hip it will be gauged a greater distance from upper edge of rafter than on common rafters, owing to its lesser pitch.

10. Time consumed on this lesson should not be more than five hours.

SUGGESTIONS FOR TEACHING LESSON 7

1. Explain what is meant by unequal pitch and how it affects the jack rafters on either side of the hip rafter.
2. Show how the run of an unequal pitch hip or valley may be found from the roof plan and how to find the figures to use for plumb and level cuts.
3. Show how length may be found by right angle triangle theorem, by scaling and by stepping off with steel square. Figures for stepping off may be found by dividing total run of unequal pitch hip by number of runs used to step off common rafter. This result taken on blade of square and the rise per foot used for common rafters taken on tongue will give figures to step off rafter.
4. Show how to treat the foot of hip rafter when no backing is to be used.
5. Explain how unequal pitch hips affect some kinds of cornices and why in some cases such hips must not run beyond plate.
6. Student should be able to find figures for bevel at top of rafter applying what has been taken up in previous lessons. From this lesson on the teacher should see that students think out as many problems as possible themselves.
7. Time consumed on this lesson should not be more than three hours.

SUGGESTIONS FOR TEACHING LESSON 8

1. Explain similarity between hip and valley rafters as regards laying out, bringing out the point that the foot of valley rafter must be laid out so that corners of upper edge lie in the same plane as the common rafters of roof.
2. Explain why one valley rafter shown on plate runs to ridge board of main roof and how its upper edge must be beveled where it extends above ridge of smaller roof. This bevel is similar to backing used for hips.
3. Call attention to the fact that the short valley must be shortened at its upper end one-half thickness of long valley and this distance must be measured square back from the plumb line.
4. Discuss the procedure for laying out valleys for unequal pitch roofs and why it is sometimes necessary to have plates of different levels in order to have same cornice construction.
5. Time consumed on this lesson should not be more than three and one-half hours.

SUGGESTIONS FOR TEACHING LESSON 9

1. Explain why figures used to lay out bevel on hip or valley may also be used for bevel of jacks.
2. Discuss the three methods which may be used to find length of jacks, namely: Scale drawing, proportion and steel square.
3. Show how the run of an equal pitch hip and valley jack (sometimes called cripple jack) is related to the length of plate between foot of valley and hip.
4. Discuss proper way to nail jack rafters in place so that hip or valley rafter will be kept straight or straightened if crooked or warped.
5. Have student lay out, cut and nail in place at least two of each kind of jack rafters. Trace with finger the triangle formed by hip rafter, common rafter and plate between feet of such rafters and see if student can find figure to use for cutting roof boards for hip.
6. If student has finished work set forth and there is available time have a dormer window framed on roof or frame up hexagon or octagon hip roof on frames constructed in Lesson 4.
7. If there is available room in a corner of workshop, chalk out lines on floor representing corner of building and have entire class working as a gang frame a section of a roof, using full-sized material.
8. Time consumed on this lesson should not be more than five hours.

6. MEASURING, RATING, AND RECORDING

Student's work.—Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the Committee on Courses of Study for Disabled Soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second schools.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*; while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor, nor should this rating be influenced by personal feelings, such as dislike or grudge. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- (1) Execution of work:
 - (a) Time—Is the student rapid, moderate, or slow in executing his work?
 - (b) Technique—Does the student use workmanlike methods?
Does he exercise reasonable economy in use of materials?
Is he neat and orderly in care of tools?
- (2) Finished product:
 - (a) Accuracy—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.
 - (b) Quality—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
 - (c) Mastery of principles—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?
- (3) Interest:
 - (a) Attitude toward work—Does the student love his work or does he watch the clock?
Is he likely to continue in this line of work?
 - (b) Studiousness—Does the student show disposition to study the printed literature related to this work?
Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) Possibilities of growth—Is the student likely in due time to receive promotion to positions of greater responsibility?
- (4) Test problem:

A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

REFERENCE BOOKS NECESSARY FOR COURSE

1. Carpentry. Gilbert Townsend. American School of Correspondence, Chicago, Ill. Price, \$1.
2. The Steel Square and Its Uses. Wm. A. Radford, A. W. Woods, and Wm. Reuther. Industrial Publishing Co., 16 Thomas Street, New York. Price, \$1.50.
3. The Steel Square. Morris Williams. American School of Correspondence, Chicago, Ill. Price, \$1.
4. Framing. Wm. A. Radford, Alfred Johnson, and Bernard L. Johnson. The Radford Architectural Co., Chicago, Ill. Price, \$1.
5. Sargent Tool Book. Sargent & Co., 94 Center Street New York. Trade catalogue, free.

EQUIPMENT AND MATERIALS

The following tools and materials are required for a class of five students.

1. Individual equipment

5 steel squares, 16" tongue with board measure.	5 marking gauges, boxwood.
5 saws, crosscut, 20", 10-point.	5 jack planes, 14", 2" cutter.
5 2 ft. four-fold, boxwood rulers.	5 backsaws, 10", 12 point.
5 hammers, 13 oz., bell face, adze eye.	5 bench hooks (shop made).
5 nail sets, $\frac{1}{16}$ " point.	5 sliding T bevels, metallic handle, 6".
5 1" chisels, tang firmer.	5 vises, toles, 10", iron, wood faced (may be omitted).
5 $\frac{1}{2}$ " chisels, tang firmer.	

2. General equipment

2 steel squares with rafter tables.	1 saw vise (may be shop made).
3 saws, rip, 24", 6-point.	1 screw driver, 8".
3 dividers, 8", loose-leg, wing.	1 hand grinder, 6" wheel.
1 drawing knife.	1 level and plumb, wood.
1 mallet.	6 10" iron C clamps.
1 oiler, brass, $\frac{1}{2}$ pint.	3 brad awls, $\frac{1}{8}$ " point.
1 oilstone, coarse and fine face, carborundum.	3 fences, steel square (shop made).
2 pliers, combination, wire cutting.	1 plumb bob, brass, 12 oz.
1 carpenter's pincers, 8".	1 hatchet, lathing, $2\frac{1}{2}$ " cut.
1 saw set.	1 doz. carpenter's pencils, 7".
6 files, slim taper, triangular 6".	1 doz. Eagle or Faber pencils, 2H.
6 files, slim taper, triangular 5"	1 brace, ratchet, 6" sweep.
2 files, flat, second cut, 10"	1 set (13) auger bits, Jennings pattern, No. 4-16 to 16-16, inclusive.
2 knives, sloyd.	

Bill of hardware

2 lbs. $\frac{3}{4}$ " No. 18 brads.	10 lbs. 4d. common wire nails.
2 lbs. 1" No. 17 brads.	10 lbs. 8d. common wire nails.
3 lbs. $1\frac{1}{4}$ " No. 16 brads.	10 lbs. 10d. common wire nails.
5 lbs. $1\frac{1}{2}$ " No. 16 brads.	10 lbs. 20d. common wire nails.
5 lbs. $1\frac{3}{4}$ " No. 15 brads.	1 gross screws, 1" No. 7, F. H. Bright.
5 lbs. 2" No. 13 brads.	1 gross screws, $1\frac{1}{4}$ " No. 8, F. H. Bright.
5 lbs. 3d. common wire nails.	1 gross screws, $1\frac{1}{2}$ " No. 10, F. H. Bright.

Bill of lumber

Poplar, white pine, cypress or spruce may be used for this course. If possible lumber listed should be obtained ripped to sizes listed.

50 ft. $1\frac{1}{2}$ " or 2" lumber ripped to $1\frac{1}{2}$ x 2".	300 ft. $\frac{1}{2}$ " lumber ripped to $\frac{1}{2}$ x 1"; $\frac{1}{2}$ x $1\frac{1}{2}$ "; $\frac{1}{2}$ x 2".
50 ft. $\frac{3}{8}$ " lumber ripped to $\frac{3}{8}$ x 2".	100 ft. 1" lumber ripped to 1 x 4"; 1 x 2".

Also the following building lumber for full-sized work:

6 pieces 2 x 4 x 16' 0" spruce, hard pine, fir.	8 pieces 2 x 6 x 16' 0" spruce, hard pine, fir.
6 pieces 2 x 8 x 16' 0" spruce, hard pine, fir.	6 pieces 1 x 8 x 16' 0" spruce, hard pine, fir.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS TO STUDENTS

1. Keep work bench clear of tools not being used, shavings, waste material, nails, etc.
2. Make a small nail box for your own use containing about six compartments.
3. Do not begin a problem until you have looked up references available and mastered the principles involved.
4. Make all cuts carefully and accurately. If saw runs, it should be jointed and filed at once.
5. When making beveled cuts for ends of hip, valley, and jack rafters, incline the material being cut so that the saw blade lies in a vertical plane. Both lines then can be seen at all times.
6. The proper way to hold the steel square when stepping off a rafter is with the blade in the left hand and heel of square to the front.
7. When nailing work together use nails that will hold firmly but will not split material. Small nails toe-nailed and set with nail punch will hold better than larger ones driven straight in.
8. Avoid hammer marks on all work; it is a good habit to acquire.
9. All roof framing is based upon the right angle triangle, the run of a rafter being the base and the rise of a rafter being the height or altitude. Learn the mathematics of the right angle triangle (Pythagorean theorem), as it will often be useful in proving difficult work.
10. If, when cut, a jack or hip does not fit, do not try to make it fit by planing or chiseling. Discard it, check your figures and lay out another one. The spoiled material may be used for a shorter rafter.

Lesson 1

Problem: Markings on the steel square.

A. Study:

Octagon scale, brace measure, Essex board measure, rafter table.

Pages 29-32, Sargent Tool Book.

Pages 1-4, Steel Square, Morris Williams.

Pages 19-32, Steel Square, vol. 1, Radford.

B. Construction:

1. On a piece of material 10" square, lay off an octagon, using square and dividers.
2. On a piece of 1 x 3" lumber 6 or 8 ft. long lay off a brace, to be placed 4 ft. each way from the corner of two timbers, meeting at right angles. (Brace measure.)
3. Using the board measure, find the number of feet in two or three pieces of lumber lying about the shop. Check by arithmetic.

C. Questions:

1. Name the three parts of the square.
2. Which side of the square is the face?
3. Where is the octagon scale found? Explain its use.
4. What is on the side opposite the octagon scale? Describe its use.
5. What is found on the back of the blade?
6. What is a board foot?
7. How many board feet in a piece of timber 3" thick 6" wide and 9 ft. long?
8. What is the cost of a board 1" thick 9" wide and 17 ft. long at 12c. per board ft.?
9. What is the diagonal distance across a square room measuring 36 ft. on a side?
10. The inches along the outer edge of the back of the square are graduated into twelfths. How may they be used to advantage?
11. Find, by using two squares, the length of the diagonal of a rectangle measuring 4' x 7'.

Lesson 2

Problem: Bridging.

A. Study:

Application of the square in finding length and cuts for cross or diagonal bridging used between floor joists and between partition studs.

See pages 140-142, Steel Square, vol. 2, Radford.

See pages 56-57, Carpentry, Townsend.

B. Construction:

Cut 4 pieces of stock 1 x 4 x 12'' to represent floor joists. Nail them to 2 pieces of stock 1 x 3 x 20'' representing sill. Vary the spacing between centers of joists 5 to 8''. Cut and nail in between these 4 joists one row of cross bridging, stock $\frac{1}{2}$ x 1''.

C. Questions:

1. What two measurements must be taken to cut bridging?
2. Why are the figures applied to opposite sides of material?
3. What is the value of bridging?

Lesson 3

Problem: Stair building.

A. Study:

1. How to determine rise and run. Page 153, Steel Square, vol. 1, Radford.

2. Plate, page 154, Steel Square, vol. 1, Radford.

3. Way to make a pitchboard. Page 155, Steel Square, vol. 1, Radford.

4. How to lay out stairs. Pages 130 and 131, Framing, by Radford.

B. Construction:

1. Lay out on a 1 x 4 board, step-ladder string, tread $4\frac{1}{2}$ '', rise 14''.

2. Lay out on a board 1 x 10 x 16', stair string, floor to floor, 9' 11''—total run space available, 12' 9''. Calculate rise and run for laying out above.

Lesson 4

Problem: Hexagon and octagon. (Polygons frequently used in framing.)

A. Study:

Figures to use for mitering and lapping corners of polygons.

See pages 4-8, Steel Square, Williams.

See pages 59-102-103, Framing, Radford.

See pages 209-212, Steel Square, vol. 1, Radford.

See pages 43-50, Steel Square, vol. 2, Radford.

B. Construction:

1. Lay out, cut, and nail together a hexagon, using stock 1 x 2''. Miter three of the corners and lap the other three. Side of the hexagon is to be 12''.

2. Lay out, cut, and nail together an octagon, stock 1 x 2''. Miter four corners and lap four. Size of octagon 24'' between parallel sides. These frames may be used later on in course for optional work in framing a hexagon and octagon hip roof.

C. Questions:

1. What is the miter angle of a hexagon?
2. What figures on the square give this angle?
3. What other angle may be found with these same figures?
4. What is the miter angle of an equilateral triangle?
5. If the distance between parallel sides of a hexagon is 30'', what is the length of one side?
6. What is the miter angle of an octagon?
7. What figures are used to give this angle?
8. Where pieces are lapped or halved, what figures are used?
9. The distance between parallel sides of an octagon is to the length of one side as 12 is to 5. How may this be used to find the length of the side of an octagon measuring 6 ft. between parallel sides?
10. The side of an octagon is 20''. What is the distance between parallel sides?

Lesson 5

Problem: Common rafter.

A. Study:

Various terms used in roof framing and how to lay out rafters with and without overhang for cornice.

See page 28, Sargent Tool Book.

See pages 97, 98, and 105, Framing, Radford.

See pages 77-79, 88-89, Carpentry, Townsend.

See pages 40 to 47, inclusive, Steel Square, vol. 1, Radford.

See pages 11, 12, Steel Square, Williams.

B. Construction:

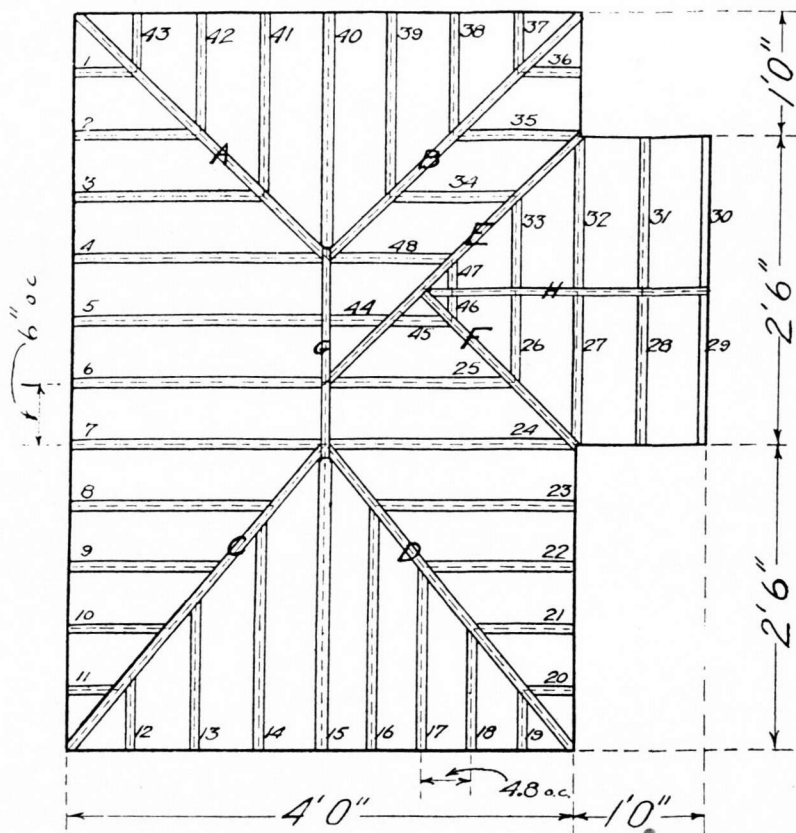
1. Step off on a piece of stock $\frac{1}{2} \times 2'' \times 10$ ft., a rafter, without overhanging, for a gable roof 10 ft. wide; rise, 8'' to the foot. If a square with rafter table is to be had, check answer.
2. Using rafter table on steel square, lay out on opposite side of stock, rafter for shed roof. Width of shed 4 ft., $\frac{1}{3}$ pitch.
3. Clean lines off stock used for above problems and lay out rafter for gable roof. Building 12 ft. wide, rise 9'' to foot run. Overhang of rafter to have run of 16''. Ridge board 1'' thick. Bird's mouth notch for plate. Have instructor check when finished.

C. Questions:

1. Illustrate the different styles of roofs and name each style.
 2. Which style is the most common for cottages?
 3. What is meant by rise and run of rafter?
 4. What is pitch?
 5. Show by sketch or diagram, position of plate—ridge—common rafters—jack rafters—hips and valleys.
 6. Define framing line. When is it used?
 7. What is meant by plumb cut, level cut, and bevel?
 8. What is meant by backing?
 9. Explain how a roof may be framed without backing.
 10. Name the different kinds of rafters and explain their positions.
 11. If there is a fraction of a foot in the run of a rafter, how is it dealt with?
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HIP AND VALLEY ROOF

Scale 1"=1'



Lesson 6

Problem: Roof framing. Hip rafters (equal pitch).

A. Study:

Plan of hip and valley roof shown in cut. Study what is meant by equal and unequal pitch and note that such pitches occur.

See pages 9, 16, 17, 23, 24, Steel Square, Williams.

See pages 92, 93, 100, 101, and 166 to 169, inclusive, Steel Square, Radford.

See pages 99, Carpentry, Townsend.

See pages 100 to 102, Framing, Radford.

B. Construction:

1. Construct plate as shown in cut, using $1\frac{1}{2} \times 2''$ stock, halving corners and bracing securely so that it will retain shape with handling. Practice may be had here by stepping off brace and steel square.
2. Lay out position of rafters, spacing 6'' on centers.
3. Get out the following sized material for the work: Hip and valleys, $\frac{1}{2} \times 2''$; common, $\frac{1}{2} \times 1\frac{1}{2}''$; jack, $\frac{1}{2} \times 1\frac{1}{2}''$; ridge board, $\frac{3}{8} \times 2''$.
4. Select rise per ft. (say 9'') and step off two common rafters of main roof which hit ridge with square cut on upper edge.
5. Lay out, cut ridge board for main roof, and nail common rafters No. 5 and No. 6 to plate and ridge, bracing ridge so that it is proper distance above level of plates.

Problem: Roof framing. Hip rafters (equal pitch)—Continued.

B. Construction—Continued.

6. Lay out equal pitch, hips A and B, using 17 on blade of square and same rise as used for common rafter.
7. Lay out bevel at top of hip, making proper deduction for ridge.
8. Determine proper backing to use and lay out rafters for backing. Note that vertical distance at heel of rafter at plate must be made same as common rafter.
9. Cut and nail regular hips in place, bracing up ridge board securely.

C. Questions:

1. Define framing line. When used?
2. What other method may be used?
3. How is deduction made for ridge board on common rafter?
4. Hip rafter?
5. Why is 17" used on blade to run hip? Can this figure be used for any kind of a hip?
6. What is backing?
7. How is the square applied to a hip or valley timber to cut bevel that will fit the top end against ridge?
8. Is it necessary to back hip rafters in small buildings?
9. What angle does a regular hip make with side of building?
10. If you know square root, prove the length of the hip and common rafters you have cut.
11. Make a drawing showing the application of the square in finding the relative height or valley per ft. of run to that of the common rafter.

Lesson 7

Problem: Roof framing. Hip rafters (unequal or irregular pitch).

A. Study:

Plan, and note hips at end of roof having unequal pitch.
Review references given in lesson 6.

B. Construction:

1. Determine the total run of the irregular hips, which will be the diagonal of 24 and 30. This may be done by square root or by scaling with steel squares. This figure and the total rise of common will give plumb and level cuts. Diagonal of these figures will give length. Another method is to find rise per ft. of run by proportion and then stepping off length.
2. Figures for bevel at top of rafter to fit against ridge will be length of long common rafter No. 15 on blade and run of short common No. 7 on tongue; inches on square representing ft. on building. Blade gives cut.
3. Lay out these hips, check and cut. Omit backing, as it is not always necessary, but caution must be taken to have vertical distance same as on common rafter at plate.
4. Nail securely in place, checking all distances and keeping ridge level.

C. Questions:

1. Explain why 17" and the rise per ft. of common rafter could not be used to lay off hip rafter of unequal pitch?
2. Show by diagram why run of short common and length of long common give bevel for top of hip.
3. What other work must these figures be used for?
4. How is length of long common rafter found on square?
5. Suppose this rafter did not run in from center of building and hit end of ridge board, what could you do?
6. The long common rafter is thicker than ridge board. What must be done to the upper end to make it fit between the hips?
7. What figures must be used?
8. It will be noted that jack rafters on one hip meet, on the other they do not. Which is the better construction?
9. On what kind of cornice must they be placed as shown at C?
10. Note carefully on a board or piece of paper, all figures you have obtained so far and how used.

Lesson 8

Problem: Roof framing. Valley rafters.

A. Study:

- Position of valley rafters, noting that one runs to ridge board.
- See pages 14 to 20, Steel Square, Williams.
- See pages 106 to 108, Framing, Radford.
- See pages 63 to 69, inclusive, Steel Square, vol. 1, Radford.
- See pages 106, 189, Steel Square, vol. 1, Radford.
- See pages 97, Carpentry, Townsend.

B. Construction:

1. Lay out long or supporting valley similar to hip B. Make proper deduction for ridge and note that where side of rafter meets plate vertical distance must be same as common rafter.
2. Cut and nail in place. Center line of rafter continued should intersect center line of ridge in center of building.
3. Lay out and cut common rafters No. 28, No. 29, No. 30, No. 31.
4. Determine length of ridge by figures shown on plan. Cuts at end of ridge hitting valleys will be miter cuts on edge and plumb on side.
5. Erect and nail in place ridge and common rafters.
6. Determine run of short valley. Lay out, making deduction for long valley and nail in place.

C. Questions:

1. Would long valley be parallel to hip if pitch of smaller roof were greater or less than main roof?
2. If such were the case, would the end of ridge board be mitered?
3. What must be done to upper edge of long valley above point of intersection with short valley and ridge board?
4. Why does one valley run to ridge board?
5. Could the short valley have been prolonged instead of the one shown on plan?
6. If so, what would the support of the upper end be?
7. What figures would be used for edge and side cuts if such was the construction?

Lesson 9

Problem: Roof framing. Jack rafters.

A. Study:

- Location of the following on plan: Hip jacks, equal pitch; hip jacks, unequal pitch; valley jacks; hip and valley jacks.
- See pages 56, 78, vol. 1, Steel Square, Radford.
- See pages 87, 89, 106, 115, Steel Square, vol. 2, Radford.
- See pages 100, 101, Framing, Radford.
- See pages 17 to 21 Steel Square, Williams.
- See pages 101, Carpentry Townsend.

B. Construction:

1. Lay out common rafters hitting end of main ridge.
2. Determine bevel used to fit them between hips.
3. The length of jack rafters may be found by proportion or by scaling the length, using two steel squares. The side cuts are the same as for common rafters and the top or edge cut is similar to that used for hip and valleys. It may also be found by taking 12" on tongue and length of the common rafter for one foot of run on blade. Blade gives cut.
4. Length of jacks No. 2, No. 42, No. 38, No. 35 may be found by finding diagonal of 9 and 12, the rise of common rafter for 1 ft. of run. From these the others may be found.

Problem: Roof framing. Jack rafters—Continued.

B. Construction—Continued.

5. Length of small jacks No. 11 and No. 20 may be found by proportion thus:
Run of long common, length of short common, distance from corner,
length of first jack. This method may be used to find all others also.
The vertical distance on jacks No. 11 and No. 12 at corner of plate must
be the same.
6. If there is available time, lay out, cut and nail in place the other valley,
hip and valley jacks.

C. Questions:

1. Where jacks are nailed to hip, what would the result be if all the jacks were
nailed on one side of the hip first?
2. Which of the methods used to space rafters on hips C and D tends to give
a straighter hip?
3. How are the lengths of jacks No. 35, No. 34, No. 48 found?
4. What figures must be used for the bevels of jack No. 45? How is the length
of this rafter found?
5. What figures would be used to find miter of roofing boards for hips of equal
pitch?

Rehabilitation monograph. Joint Series No. 41.

Unit Course—Woodworking 2—Care of Woodworking Tools

WOODWORKING

February, 1919—Trial edition

PART 1. INSTRUCTORS' MANUAL

1. QUALIFICATIONS OF STUDENT

This course is intended for one who expects to use common woodworking tools. Previous experience is not necessary. The lessons proceed from the simple to the difficult, so that anyone may follow them and become proficient in the upkeep of a kit of woodworking tools.

2. AIMS OF THE COURSE

- (a) To enable any user of woodcutting tools to keep them in a condition to do efficient work.
- (b) To show that certain definite principles underlie the proper grinding and sharpening of all woodworking tools.
- (c) To show that efficient work depends very largely upon the proper care of tool equipment.
- (d) To give a certain amount of practice in the upkeep of a kit of woodcutting tools under proper direction and supervision.

3. LENGTH OF THE COURSE

This course is outlined to cover twenty hours of instruction, study, and practice. Modifications may be necessary to bring the work within the time limit. These may be made by the instructor in charge.

4. OUTLINE OF LESSONS

- | | |
|---------------------------------------------------|------------------------------------------------------|
| 1. Grindstones and grinders. | 13. To sharpen a scraper. |
| 2. To sharpen chopping tools. | 14. To grind and sharpen cutters of moulding planes. |
| 3. To true a grindstone. | 15. To sharpen an auger bit and rose countersink. |
| 4. To grind a firmer chisel. | 16. To sharpen a Forstner bit. |
| 5. To grind a plain blade. | 17. To joint and set a handsaw. |
| 6. Whetstones, kinds and uses. | 18. To file a rip saw. |
| 7. To sharpen or whet chisel or plane blade. | 19. To joint and set a crosscut saw. |
| 8. To true a whetstone. | 20. To file a crosscut handsaw. |
| 9. To replace a broken chisel handle. | |
| 10. To grind a gouge. | |
| 11. To whet a gouge. | |
| 12. To grind and whet a drawknife and spokeshave. | |

5. MEASURING, RATING AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*, the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

- (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
- (b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

(2) Finished product:

- (a) *Accuracy*.—Should be determined by the record kept of errors in judgment.
- (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

- (a) *Attitude toward work*.—Does the student love his work, or does he watch the clock? Is he likely to continue in this line of work?
- (b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?
- (c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

NOTE.—The condition of student's tools at end of course will be a good indication of his mastery of the subject.

GENERAL SUGGESTIONS TO INSTRUCTORS WHO MAY CONDUCT THIS COURSE

1. Prepare each lesson before the time set for giving it.
2. Have some definite object to teach in each lesson and make all work point toward that object.
3. Do not lecture. Develop each lesson carefully. Build each lesson upon the lesson that has gone before and with which the student is familiar.

4. Use blackboard freely to illustrate and make clear the important points in each lesson. These illustrations need not be elaborate, but simply rapid sketches drawn during the lesson.

5. Do not do the work for the student.

6. Keep the class interested in the work by asking well-worded questions that tend to make them think about the work in hand.

7. Demonstrate the steps in each lesson carefully and then point out some of the difficulties that are to be encountered.

SUGGESTIONS FOR TEACHING

Lesson 1.—Grindstones and grinders

1. Explain carefully the differences between sandstone grindstones and electrically fused grinders. Be particular to lay stress upon the advantages and disadvantages of each.

2. Call attention of the students to the fact that all cutting tools are hardened and this hardness is drawn to the proper degree by means of heat. Any reheating destroys this temper and renders the tool worthless.

3. Impress upon the students the need of water on the grindstone.

4. Supply samples of badly nicked tools and also blunt edge tools to illustrate when tools should be ground.

Lesson 2.—To sharpen chopping tools—Axe, adz

1. Demonstrate several methods of holding axe on stone.

2. Explain carefully the cutting actions of the axe and adz.

3. Bring to the attention of the students the relation which exists between the cutting action of the tool and the correct bevel.

4. Explain the difference between the work of the axe and that of the adz and point out that this governs the position of the bevel on the tool.

5. Point out why woodsmen are supplied with double bitted axes.

6. Review the action of heat on the edge of tools.

Lesson 3.—To true a grindstone or a grinder

1. Explain what is meant by a dull or glazed stone or grinder.

2. Demonstrate carefully that truing not only makes the stone flat on the edge, but it also softens up the grit and makes it cut faster.

3. Illustrate the methods of truing a stone.

4. Point out the fact that grindstones and grinders must be used for tool grinding only.

5. Explain the fact that a stone which runs eccentric is not a good stone to work with for grinding tools.

Lesson 4.—To grind a firmer chisel

1. Make large wood model of blade of chisel to show correct bevel.

2. Compare the cutting action of axe and chisel.

3. Explain how the use of the chisel determines the size of angle between the flat and bevel side.

4. Point out that wire edge represents steel ground away or wasted and that grinding should stop when this edge appears.

5. Explain carefully why the flat side of chisel should never be placed on the grindstone.

6. Demonstrate the ways of supporting the chisel while grinding.

7. Point out that movement of chisel from side to side prevents wearing the stone out in one place.

8. Distinguish between grinding bevel and whetting bevel.

Lesson 5.—To grind a plane blade

1. Construct large wood models of various plane blades showing the cutting edge and the bevel.

2. Compare the cutting action of grindstone and grinder.
3. Compare the cutting action of the chisel and plane blade.
4. Point out how use determines cutting edge and bevel.
5. Explain the similarity of grinding between the chisel and the plane blade.
6. Point out the benefit to be derived from a hollow-ground chisel or plane blade.
7. Explain why blade is not ready for use when ground.

Lesson 6.—Whetstones, kinds and uses—Prepare strap

1. Compare the various kinds of stones as to kind and degree of finess.
2. Point out that cutting action depends upon the coarseness of the grit.
3. Point out that finess of cutting edge depends upon the grit of the stone used to sharpen the edge.
4. Explain why oil is necessary to use on the whetstone.
5. Demonstrate why the use of an oilstone is necessary to quick work.

Lesson 7.—To sharpen or whet a chisel or plane blade

1. Construct large wood models showing the bevel produced by the oilstone. Show on the same model the bevel that will be produced if handle of chisel be raised when flat side is being rubbed on the stone.
2. Explain that all tools should be tested before using and if need be sharpened.
3. Point out the fact that tools may be whetted several times before being ground.
4. Demonstrate with the use of the model and by blackboard sketches that chisels and plane blades will not do the work for which they are intended if a bevel be made on the flat side.
5. Demonstrate the fact that the higher the chisel handle is raised when sharpening the blunter will be the bevel and the more frequently the chisel will have to be ground.
6. Explain why it is better to have the strokes in sharpening run the full length of the stone.
7. Point out the fact that stones will gum and be unfit to use if they are not cleaned each time they are used.

Lesson 8.—To true a whet or oil stone

1. Secure an oilstone with an irregular surface and show the effect of sharpening tools upon it.
2. Point out the fact that an oilstone with a hollow or irregular surface means poorly sharpened tools. This means poor work.
3. Demonstrate that a stone rubbed in one direction is likely to have ridges in it instead of being smooth.
4. Point out that it is not necessary to have the surface of the oilstone square to the sides of the stone but it must be flat and smooth.
5. Discuss the cutting qualities of the various abrasives.

Lesson 9.—To replace a broken chisel handle

1. Compare the effect of the use of the hammer and mallet upon the handle of the chisel.
2. Demonstrate the method of placing a new handle on a chisel.
3. Lay emphasis upon the fact that the chisel must be tight in the handle for efficient work. Chisel must be straight in the handle.
4. Impress upon the student that chisel handles must be marked in order that they may be driven straight in the handle every time they are taken out.
5. Show that handles may be made of applewood, hickory, ash.

Lesson 10.—To grind a gouge

1. Compare the cutting action of the gouge and the firmer chisel.
2. Compare the method of grinding the gouge with that of grinding the firmer chisel.
3. Show how the use of the gouge governs the shape of the cutting edge and the side upon which the bevel is to be ground.
4. Show how the cone shaped grinder may be made of wood and emery powder.
5. Demonstrate the method of holding the gouge so that a curved edge may be ground.

Lesson 11.—To whet or sharpen a gouge

1. Compare the whetting of the gouge with that of the firmer chisel.
2. Demonstrate the method of sharpening the two types of gouges.
3. Point out the effect of raising the handle of the gouge too high when sharpening.
4. Explain the result of not holding the slip tightly against the chisel when removing the wire edge.
5. Explain why the use of the strop is so necessary when finishing the sharpening of the gouges.

Lesson 12.—To grind and whet a drawknife and spokeshave

1. Demonstrate carefully the method of grinding and sharpening the drawknife and spokeshave.
2. Compare the cutting edge of drawknife with that of firmer chisel.
3. Show how the cutting action of the tool determines the angle of ground bevel and the cutting edge.
4. Point out why the spokeshave has the same bevel as the drawknife.
5. Make small holder for holding the spokeshave cutter while it is being ground.

Lesson 13.—To sharpen a scraper

1. Illustrate the cutting edge of the scraper on the blackboard.
2. Compare the cutting action of the scraper and the plane.
3. Demonstrate the two methods of obtaining the edge of the scraper, grinding and filing.
4. Show how a burnisher may be made from a file.
5. Carefully demonstrate the method of sharpening the scraper and point out the effect of turning the burr over too far.
6. Discuss files to be used as aids in sharpening tools, namely, flat files and saw files.

Lesson 14.—To sharpen the cutter of a moulding plane

1. Make large model of rabbet plane cutter showing the proper angle of the cutting edge and the clearance.
2. Compare the cutting action of plane cutting with the grain and plane cutting across the grain and explain how this governs position of cutter in the plane stock, angle of edge, and angle of clearance.
3. Demonstrate how round file may be used in lieu of grinding wheel with curved edge.
4. Point out that all irregular-edged planes will not work very efficiently unless very sharp.
5. Show similarity of bevel between this and other planes.

Lesson 15.—To sharpen an auger bit and a rose countersink

1. Explain carefully the cutting action of the auger bit. Show how the nibs cut the fibers and the lips cut and remove the wood between the cuts made by the nibs.
2. Show why it is necessary to file a bit with extreme care.
3. Demonstrate why the nibs must be long and thin rather than short and thick.
4. Point out the reason for filing on the inside of nibs and not on the outside.
5. Compare the cutting action between the auger bit and the countersink.

Lesson 16.—To sharpen a Forstner auger bit

1. Compare the work of the Forstner bit with that of an ordinary auger bit.
2. Show why the bevel on the cutting rim must not be made too blunt.
3. Demonstrate the method of making a scraper for this job from a file.
4. Show that the same work may be accomplished with a slip stone of the proper shape.
5. Demonstrate how the bit is sharpened.

Lesson 17.—To joint and set a handsaw

1. Make large wood models of saw teeth, both rip and crosscut.
2. Use model to demonstrate the cutting action of the rip saw.

3. Show that if saw teeth are not even the saw will jump when used.
4. Explain that saw must be jointed square or the teeth on one side will be higher than teeth on the other side.
5. Impress upon the students that set is necessary or the saw will bind when used.
6. Explain that too much set means waste of wood and waste of energy.

Lesson 18.—To file a hand rip saw

1. Use Disston's saw chart to help in this demonstration.
2. Show how to make a wood saw clamp for filing saws.
3. Explain from wood model what part of saw tooth does the cutting.
4. Illustrate and point out carefully the angles at which the file must be held.
5. Explain why more hook may be given the cutting edge of the rip saw when cutting softwood than when cutting hardwood.
6. Demonstrate very carefully the way in which the saw should be filed.

Lesson 19.—To joint and set a crosscut saw

1. Explain the method of setting the saw with a small peen hammer.
2. Explain the meaning of taper ground and show what effect it has on the set of the saw.
3. Show that for fine work the less set a saw has the better. The character of the cut may be shown by having two saws filed the same but set differently.
4. Review carefully the steps of lesson 17.

Lesson 20.—To file a crosscut handsaw

1. Use charts and diagrams of teeth to simplify this demonstration.
2. Compare the angle at which the file is held when filing the rip saw with the angle at which the file is held when filing the crosscut saw.
3. Show the various angles which may be used to file the crosscut saw teeth.
4. Illustrate and compare the cutting edge of crosscut saw with that of the rip saw.
5. Point out that irregular teeth mean rough edges on sawed boards.
6. Compare the kinds of files used for filing saws of different sized teeth.

Reference books for teachers and students

1. Woodwork for Secondary Schools. Griffiths. (Manual Arts Press, Peoria, Ill.) \$1.75.
2. Handwork in Wood. Noyes. (Manual Arts Press, Peoria, Ill.) \$2.
3. Exercises in Woodworking. Sickles. (American Book Co., New York City.) \$1.
4. Benchwork in Wood. Goss. (Ginn & Co., New York City.) \$0.84.

Trade publications. Free of charge:

1. Simonds Manufacturing Co., Fitchburg, Mass.—
 - (a) How to file a handsaw.
 - (b) Simonds's Guide for Carpenters.
2. Henry Disston's Sons, Philadelphia, Pa.—
 - (a) The saw in history.
 - (b) Disston's Handbook on Saws.
 - (c) Why a saw cuts.
 - (d) Disston's Saw Chart.
3. E. C. Atkins, Indianapolis, Ind.—
 - (a) Atkins's Silver steel saws.

Equipment and materials

The following list of equipment is recommended for the students who will take up the work outlined. It is assumed that the students taking the work will be provided with the tools to sharpen. These tools are not specified in this list.

1. Individual equipment for a group of five students:

- 5 India or carborundum stones—fine, 2 x 8" face.
- 5 India or carborundum stones—coarse, 2 x 8" face.
- 5 India or carborundum slips—fine, 4 x $\frac{3}{8}$ " to $\frac{1}{2}$ ", rounded edges.
- 5 India or carborundum slips—coarse, 4 x $\frac{3}{8}$ " to $\frac{1}{2}$ ", rounded edges.
- 5 India or carborundum slips—fine, 4 x $\frac{1}{8}$ " to $\frac{3}{16}$ ", rounded edges.
- 5 India or carborundum slips—coarse, 4 x $\frac{1}{8}$ " to $\frac{3}{16}$ ", rounded edges.
- 5 burnishers.
- 5 flat files, double cut, 8".
- 5 saw files, slim taper, 6".
- 5 saw files, slim taper, 5".
- 5 auger-bit files.
- 5 knife-edge files 6".
- 5 handles for saw files.
- 5 saw sets.
- 5 saw joiners.
- 5 pieces whitewood or pine $\frac{3}{4}$ x 2 x 8".
- 5 pieces clean harness leather $\frac{1}{8}$ x 2 x 6".
- 5 small oilers.
- 5 light riveting hammers, about 4 oz.

2. General equipment:

- 1 grindstone $3\frac{1}{2}$ x 30", either foot or power driven.
- 1 grinder such as Niagara No. 4, either foot or hand driven.
- 1 grinder wheel $\frac{3}{8}$ " thick, rounded edge to fit above grinder.
- 1 Huntington emery wheel dresser (extra cutters).
- 1 metal saw-filing clamp.
- 2 pieces gas pipe $\frac{1}{2}$ x 24".
- 1 Arkansas stone, hard, 2 x 8" face.
- 1 Arkansas stone, soft, 2 x 8" face.
- 1 Washita stone, 2 x 8" face.
- 5 lbs. No. 46 emery powder.
- 2 lbs. Fine Flour emery powder.
- 1 bale cotton waste.
- 1 gal. liquid glue.
- 2 gals. kerosene.
- 2 gals. sperm oil.
- 1 large oiler to hold 1 pint.
- 1 surface plate, cast iron, $\frac{7}{8}$ x 12 x 12".
- 1 hard-maple plank 2 x 10 x 16", dressed two sides.
- 1 quire sandpaper, No. 2 $\frac{1}{2}$ ".
- 1 quire emery cloth, No. 3.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL SUGGESTIONS TO STUDENTS WHO MAY PURSUE THIS COURSE

1. Study carefully all references given before going to the demonstration.
2. Follow very closely the steps listed under each lesson.
3. Try and see wherein the information gained in one lesson may be applied in succeeding lessons.
4. Keep in mind the fact that well-kept tools mean less exertion and more output.

Lesson 1.—Grindstones and grinders

Reference:

Woodwork for Secondary Schools. Page 136, par. 131.

Exercises in Woodworking. Page 82, plate "E."

Practice:

1. Examine the grindstone and note the texture of the sandstone.
2. Examine the artificial grinder and note the texture of the stone.
3. Grind a piece of metal on each one of the stones and compare the cutting action of each one.
4. Hold an old tool against the grindstone and grind wet. Note that the steel remains cool.
5. Hold an old tool against the grindstone and grind dry. Note the heating action of the stone.
6. Hold tool against the grinder until blue edge appears. Note the softness of blue edge.

NOTE.—Grindstones should not be allowed to stand in water for any length of time, as water softens the stone. Speed of the grindstone should be about 2,500 feet per minute.

Questions:

1. Read references.
2. What stones are used for grinding edged tools used in the woodworking industries?
3. What are the differences between the stones?
4. What do you mean by the temper of an edged tool?
5. Explain what happens when a blue edge appears on a tool that is being ground.
6. State two reasons for using water on a grindstone.
7. When should tools be ground?
8. What will be the result if a grindstone be allowed to stand in water?

Lesson 2.—To sharpen chopping tools, axe, adz

Reference:

Handwork in Wood. Pages 52, 87, 88.

Practice:

1. Turn water on stone and start it turning toward operator.
NOTE.—Tools may be ground with stone turning in either direction but the cutting action of the stone is greater when it turns toward the edge to be ground.
2. Hold hatchet or axe on the stone at the proper angle. The tool may be supported on small board at the center of stone or it may be held in the hand.
3. Grind the tool moving it from side to side until the bevel reaches the edge of the axe and then reverse and do the same on the other side. Repeat these operations until all nicks are removed, and the edge is slightly curved.
NOTE.—The proper angle between the two sides of the axe is about twenty degrees. The edge should have a curve of about $\frac{3}{16}$ of an inch from a straight line.
4. The adz is to be ground the same as the axe except the bevel is ground on one side only. This is owing to the fact that this tool is used to work close to a line and therefore must have one side flat.

Questions:

1. In what direction should the stone turn when grinding? Why?
2. How may the axe or adz be supported while grinding?
3. What is the proper angle for the bevel of an axe?
4. How may this bevel be roughly determined?
5. In what respect is an adz ground differently than an axe? Why?
6. On what side of the adz is the bevel ground? How do you get rid of the adz handle when grinding?
7. Read references.

Lesson 3.—To true a grindstone or a grinder

Reference:

Goss Bench Work in Wood. Page 66, par. 109.

Practice:

1. Start grindstone and apply the end of a pipe or the tang of a file near the center of the edge of the stone. Rest the pipe on the frame.
2. Move the pipe from side to side of stone revolving it at the same time. If the file be used it must be moved from side to side without revolving.
3. Continue this operation until the surface of the stone is perfectly flat and the stone is concentric.
NOTE.—A grindstone truing device may be obtained that will do this work automatically. The usual method is to do this work by hand.
4. Apply emery wheel dresser to the grinder and move from side to side until the stone runs true and the face is perfectly flat. Stones with curved edges must have the edges turned with a curve instead of being flat.

Questions:

1. Why must the grindstone and the grinder be trued up occasionally?
2. What is to be done with small pieces of quartz which are at times found in the grindstones?

Questions—Continued.

3. What three methods are used to true grindstones?
4. What do you mean by the word "glazed" in reference to a grindstone or a grinder?
5. What will be the result if oil be used on the grindstone?
6. What tool is used to true a grinder?
7. What will be the result if one carelessly grinds lead or brass on a stone used for tool grinding?

Lesson 4.—To grind a firmer chisel

Reference:

Exercises in Woodworking. Page 82.

Practice:

1. Place chisel on board at center of grindstone and at right angles to it and remove all nicks. The edge must be square to the sides of the chisel.
2. Determine the angle of bevel to be ground on the chisel. This varies from 20 to 30 degrees. The angle must be thin and sharp for soft wood and thick and strong for hard wood. The length of bevel on a 1" chisel at 20 degrees is about $\frac{5}{16}$ of an inch.
3. Rest the handle or tang of the chisel on the board or frame of the stone and move from side to side of stone.
4. Continue grinding until a light wire edge appears on the flat side of the chisel. The flat or back side of the chisel should not be placed on the stone.
5. Remove the wire edge by running the edge of the tool over the corner of a soft wood block.

Questions:

1. Why is the edge of a chisel squared up before the bevel is ground?
2. What is the best grinding bevel for tools to be used in soft wood? For hard wood?
3. How do you roughly determine the bevel?
4. Why are chisels ground with bevel on one side only?
5. In what three positions may the chisel be held while grinding?
6. Why is the tool moved from side to side?
7. How do you determine when grinding is completed?
8. What does the wire edge represent?

Lesson 5.—To grind a plane blade

Reference:

Bench Work in Wood. Pages 23, 24, par. 46–47.

Practice:

1. Use grinder.
2. Determine the kind of plane blade, single jack, jack, fore, jointer, smooth or block plane. The edge is governed by the kind of work to be done by the plane. It varies from a curve with a rise of about $\frac{3}{32}$ inch in the center in the single jack to square in the block plane.
3. Grind edge by placing the blade flat on the block at center of the stone and grind as in chisel grinding until the proper edge is obtained.
4. Determine the proper angle to grind the bevel. This will vary as did the bevel on the firmer chisel.
5. Place plane blade with bevel side against grinder and grind the bevel, moving the blade from side to side. Continue grinding until the wire edge appears.
6. Remove the wire edge as in chisel grinding.

NOTE.—The blade must not be pressed hard against the grinder, or the temper will be drawn.

Questions:

1. How does the grinder differ from the grindstone in cutting action?
2. What precaution must be taken when using the grinder?
3. What determines the cutting edge of the plane blade?
4. What kind of an edge should be given to the fore plane? The smooth plane?
5. How does the ground bevel on the plane blade compare with that given to the chisel?
6. Why should the bevel on tools of this kind be hollow ground?
7. Why is the plane blade not ready for use when the wire edge appears?

Lesson 6.—Whetstones, kinds and uses—Prepare strop

Reference:

Handwork in Wood. Pages 117-118-120-121, art. 8.

Practice:

1. Compare natural with artificial stone in reference to cutting action. See how small nicks may be removed with coarse artificial stone.
2. Mix oil for use on natural stone, $\frac{1}{4}$ kerosene and $\frac{3}{4}$ sperm oil.
3. Prepare strop. Glue piece of clean leather $\frac{1}{8} \times 2 \times 6''$ to a wood block. Rub the surface of the leather with a mixture of tallow and flour emery or a mixture of oil and flour emery.
4. Work this mixture well into the leather.

Questions:

1. What kinds of whetstones are used to sharpen chisels and other woodcutting tools?
2. How do artificial stones compare with natural stones in reference to cutting action?
3. Why do we use oil on a whetstone?
4. Why is the use of pure kerosene detrimental to a natural stone? How do you mix the oil for use on natural stones?
5. What will result if too heavy an oil is used on oilstones?
6. How do you prepare a strop?
7. Why do we cover the surface with a mixture of flour emery and tallow or oil?

Lesson 7.—To sharpen or whet a chisel or plane blade

Reference:

Exercises in Woodworking. Page 80.

Handwork in Wood. Page 59.

Practice:

1. Moisten oilstone with oil.
2. Place bevel of chisel or plane blade on the stone.
3. Raise the handle of the chisel so that top of grind or bevel just clears the stone.
4. Rub back and forth or in a circular direction until a fine wire edge can be felt on the flat side of the chisel or plane blade.

NOTE.—Avoid rocking the chisel while pushing it back and forth. A new bevel is formed by the oilstone.

5. Place flat side of chisel on stone and rub it back and forth until the wire edge is removed. Care must be exercised to hold the chisel flat on the stone at all stages of the operation of removing the wire edge.
6. Draw alternately the flat and bevel side down the length of the strop.
7. Test for sharpness by feeling the cutting edge with the thumb. Test by cutting a piece of wood.
8. Clean oilstone with waste or shavings.

Questions:

1. What stone may be used for taking small nicks from the cutting edge of the chisel?
2. Why is whole bevel not kept on the stone while sharpening?
3. What will happen if the handle of the chisel be held too high when sharpening?
4. Why is the chisel kept at the same angle to the stone at every point in the sharpening process?
5. What will happen if the handle is raised when the flat side is placed on the stone?
6. How is a very fine edge produced on the chisel?
7. Why do you clean the oilstone?
8. How do you test for sharpness?

Lesson 8.—To true a whet or oil stone

Reference:

Bench work in Wood. Page 68, par. 115.

Practice:

1. Select hardwood plank or cast-iron surface plate.
2. Mix sand and water until the mixture will run, or mix coarse emery and oil and spread the mixture upon the board or the surface plate.

Practice—Continued.

3. Place oilstone on the plate or board and rub with a circular motion.
4. Continue rubbing until the oilstone surface is smooth and flat.
5. Clean the stone and it is ready for use.

NOTE.—Coarse emery paper or garnet or sandpaper may be used instead of the sand or emery, but they are not as efficient.

Questions:

1. What will be the result if a chisel or plane blade be sharpened on a stone not having a smooth, flat surface?
2. What causes hollows to appear in an oilstone?
3. When rubbing the surface of the stone on the surface plate, why should the direction of the motion change frequently?
4. What abrasives are used to grind the stone to a true surface?
5. How do you test the surface of the stone to see if it is true?
6. What may be substituted for a metal surface plate?

Lesson 9.—To replace a broken chisel handle

Practice:

1. Drive broken handle from the chisel.
2. Secure a new handle.

NOTE.—A turned handle may be purchased or a tapered octagonal handle may be planned up. In the latter case a piece of leather must be inserted between the bolster and the handle to reduce the strain on the handle.

3. Bore hole in the handle one-half as deep as the tang is long; use auger bit slightly smaller than large part of tang. The hole must be bored straight.
4. With a drill or gimlet bit about the same size as the end of tang complete the depth of the hole the length of the tang.
5. Carefully drive handle on the tang of the chisel. Mark some one side of the bolster and handle so that handle may be put on the same way every time it is taken off.

NOTE.—If located in a large shop the hole for the tang may be burned in the handle with a burning iron slightly smaller than the size of the tang. This is the quicker way, although the charred wood is likely to cause the handle to work loose in time.

Questions:

1. What is to be done with a handle that is split or much damaged by use?
2. Why are ferrules placed on chisel handles?
3. What may be substituted for a ferrule in a hand-made handle?
4. Why is it necessary to have the chisel placed square in the handle?
5. If the hole in the handle is too small, what may happen when handle is driven on?
6. Besides making the tang fit tight, what other method may be used for preventing the handle from coming off the chisel easily?
7. What woods may be used for chisel handles?

Lesson 10.—To grind a gouge

Reference:

Handwork in Wood. Page 60.

Exercises in Woodworking. Page 80.

Practice:

Outside ground gouge—

1. Place edge against stone or grinder and grind until the edge is the proper shape.
NOTE.—The edge of the gouge may be given two forms.
(a) It may be made square to the sides of the gouge to be used for cutting corners.
(b) It may be given a slight curve for cutting grooves or carving.
2. Place bevel side against the stone at the proper angle. The same angle is to be ground as for the firmer chisel.
3. Gently roll the gouge from side to side until the proper angle is ground all around the bevel side.
4. Remove the wire edge as in lesson No. 4.

Practice—Continued.

Inside ground gouge—

1. Place edge against stone or grinder and grind edge square to sides.
2. Use cone-shaped grinder and hold chisel at proper angle to grind a 25 degree bevel on the inside or concave side of the gouge. In place of the grinder a narrow-faced grinding wheel may be used. This wheel must have a curved edge.
3. Remove wire edge as in lesson No. 4.

Questions:

1. Does the cutting action of the gouge differ from that of the firmer chisel?
2. How does the use of the gouge govern the shape of the cutting edge?
3. What is the best angle to grind for efficient work with the gouge?
4. How does the grinder for an inside ground gouge differ from that used for an outside ground gouge?
5. How does the edge of an inside ground gouge differ from that of an outside ground gouge?

Lesson 11.—To whet or sharpen a gouge

Reference:

Handwork in Wood. Page 61.

Practice:

Outside ground gouge—

1. Select slip stone of proper size of curve to fit gouge and moisten with a drop of oil.
 2. Hold slip in left hand and place the bevel of the gouge flat on the flat side of the slip.
 3. Raise handle slightly and rub on slip with a circular motion, revolving the tool so that all points of the chisel are brought in contact with the slip.
 4. Continue rubbing until a wire edge is felt on the concave side of the chisel.
 5. To remove the wire edge place curved edge of the slip stone against concave side of gouge and rub until the wire edge is removed.
- NOTE.—Care must be exercised not to raise the slip.
6. Draw bevel edge several times across the leather strop. Test on block of wood.

Inside ground gouge—

1. Select slip of proper size and moisten with a drop of oil.
2. Place curved edge of slip against inside bevel and raise slightly so that cutting bevel will be formed.
3. Rub back and forth touching every point of the bevel until a wire edge is formed on the convex side of the tool.
4. Remove wire edge by holding convex side against the flat side of slip and rubbing lightly. These gouges are sometimes finished with a buffing wheel covered with rouge.

Questions:

1. Why is the gouge not sharpened on the oil stone used for the firmer chisel?
2. How does the sharpening of the gouge coincide with that of the firmer chisel?
3. How is the wire edge removed from the gouge?
4. What will be the result if the slip is not held flat against the concave side of the chisel?
5. What will be the result if the slip is not held flat against the convex side of the inside ground gouge?
6. How does the grinding of an outside ground gouge differ from the grinding of an inside ground gouge?

Lesson 12.—To grind and whet a drawknife and spokeshave

Reference:

Handwork in Wood. Pages 61–62.

Practice:

1. Examine drawknife and spokeshave and compare the ground bevel and edge of the two.
2. Determine the bevel that is to be ground on each (about 23 degrees).

Practice—Continued.

3. Grind curved edge on knife by holding knife on block and moving from side to side.
4. Place bevel on stone holding the knife by the handles flat side up. The back may be supported by a block of wood nailed to grindstone frame.
5. Move from side to side being careful to grind edge in a regular curve and to keep the bevel the same at every point.

Remove the wire edge as in the previous lessons. Flat side of knife is not to be placed on the stone.

To whet—

1. Support the drawknife on one handle and hold the other in left hand with the ground bevel uppermost.
2. Moisten the oilstone with oil and lay stone flat on the ground bevel.
3. Lower the stone slightly and move with a rotary motion along the blade from one end to the other. This will produce a wire edge on the flat side.
4. Remove the wire edge by holding stone against the flat side and moving it from one end to the other.
5. Test on block. Spokeshave is ground and sharpened in the same way.

Questions:

1. How does the cutting action of the drawknife coincide with that of the chisel?
2. How does the ground bevel compare with that of the firmer chisel?
3. Why is the edge of the drawknife curved instead of straight?
4. Why is the angle on the spokeshave the same as that on the drawknife?
5. What is the difference between sharpening the drawknife and chisel?

Lesson 13.—To sharpen a scraper

Reference:

Woodwork for Secondary Schools. Page 70.

Practice:

1. Grind or file edge to the shape desired.
2. Hold scraper edge on oilstone square to the stone. Rub back and forth until the edge is smooth.
3. Place scraper flat side down on stone and rub back and forth, producing a fine edge.
4. Place scraper flat side on bench top and rub back and forth with burnisher drawing out a fine edge.
5. Hold scraper in hand and with burnisher held at an angle of about 15 degrees turn the burr with one slow, heavy stroke.
6. Turn opposite edge in the same manner.
7. Test by drawing flat side of thumb nail across the edge at right angles to it.

Questions:

1. How does the grinding of a scraper differ from that of a plane blade?
2. Why is the edge of a hand scraper or of scraper held in handles ground straight?
3. How may a burnisher be made of an old file?
4. Why is it necessary to hold the side of the scraper flat on the stone when rubbing it on the side?
5. What will be the result if the burr be turned over too far?

Lesson 14.—To sharpen the cutter of a molding plane

Practice:

1. Determine bevel.
2. Use emery grinder to grind such curves as may be ground on the emery wheel.
3. Use files to file such curves and edges as can not be reached by the emery wheel.
Keep bevel same on all parts.
4. Remove wire edge as in previous lessons.

To whet the cutter—

1. Use slip stone to whet various curved parts as in lessons on sharpening inside and outside ground gouges.
2. Remove wire edge by placing cutter flat on the oilstone and rubbing back and forth.

Questions:

1. At what angle to the side of the cutter should the edge of cutters of dado-rabbet planes be ground?
2. What angle of clearance should such cutters have?
3. How are the front cutters of dado plane sharpened?
4. What is the difference in cutting action between a molding plane and an ordinary plane?
5. How are beading plane cutters sharpened?
6. What files are to be used in filing cutters to shape?
7. Study various types of planes and compare the position of cutters in each plane.

Lesson 15.—To sharpen an auger bit and a rose countersink

Reference:

Woodworking for Secondary Schools. Page 80.

Practice:

1. Secure auger bit file or file with warding edge.
2. File nibs on the inside surface until a burr appears on the outside of nibs. Bit may be held against the bench while filing.
3. Remove burr by gently rubbing slipstone on the outside of nibs. Stone must be held flat against the outside of nibs.
4. File the under side of the lips, taking care to allow for clearance. Test bit by boring.
To sharpen countersink—
 1. Determine cutting edges.
 2. Secure knife edge file.
 3. File sharp edge on each small edge of countersink. File from tang to point.
Test by trying in a hole.

Questions:

1. What are the parts of the auger bit?
2. What will result if the nibs are filed on the outside?
3. Why is it necessary to give a great amount of clearance to the lips of the bit?
4. How does the cutting action of the countersink differ from that of the auger bit?
5. What files are used for the purpose of sharpening bits?

Lesson 16.—To sharpen a Forstner auger bit

Reference:

Woodworking for Secondary Schools. Page 63, par. 81.

Practice:

1. Prepare three-cornered file by grinding point to form a scraper or select a sharp-cutting slipstone with a round edge.
2. Scrape with the scraper or rub with the slip the cutting rim until a wire edge appears on the outside.
3. Remove the wire edge in the same manner as in lesson No. 11.
4. File cutters with fine file.

Questions:

1. Compare a common auger bit with the Forstner bit and note the cutting action of each.
2. Examine outside cutting rim and determine why wire edge must be removed with care.
3. What will be the result if wire edge is not removed?
4. Why is it necessary to file the cutters?
5. What kind of a file would you use?

Lesson 17.—To joint and set a saw

Reference:

Woodworking for Secondary Schools. Pages 64–70.
Disston's Why a Saw Cuts.

Practice:

Use ripsaw—

1. Examine the saw by looking along the edge from handle to point to see if all teeth are of the same height.
2. With flat file or with flat file held in saw jointer run file from heel to toe of saw.
3. Joint the teeth all the same height and give the cutting edge of the saw a slight crown from heel to toe. The crown is about one-eighth of an inch in the center.

NOTE.—It is not necessary to joint a saw every time it is filed.

4. Secure saw set and bend every other tooth from toe to heel. Reverse the saw and set the alternate teeth on the other side.

Questions:

1. What is the cutting action of the ripsaw like?
2. Why is it necessary to joint a saw?
3. Why is it necessary to have the jointed edge square to the sides of the saw?
4. What is the action of the saw set?
5. Why do we set a saw?
6. What will result if too much set be given a saw?
7. What will happen if more than the point of the saw tooth is bent over?
8. Why is every other tooth bent over?

Lesson 18—To file a hand ripsaw

Reference:

Simonds, How to File a Saw.

Practice:

1. Clamp saw in saw filing vise handle to the right.
2. Select file suitable for saw. Place the file between the teeth, holding it at right angles to a line drawn the length of the saw.
3. Begin at the toe and file every other tooth with set pointing away from you.
4. Reverse the saw and file teeth on the other side of the saw.
5. Place on the bench and run oilstone over the side of teeth on both sides of the saw. This side jointing removes the burr edge and must be very carefully done.
6. Test the cutting action of the saw and note whether it cuts easily and smooth.

Questions:

1. Which edge of the saw tooth is the cutting edge?
2. How should the file be held in reference to the teeth of the saw?
3. Why is it necessary to file one set of teeth from one side and one set from the other side?
4. Why is the saw side jointed?
5. Should the strokes of the file be upward or straight across when filing the ripsaw?
6. When may the cutting of the ripsaw be given a slight hook?

Lesson 19.—To joint and set a crosscut saw

Reference:

Benchwork in Wood. Page 32, par. 55.

Practice:

1. Examine saw and determine whether it needs jointing.
2. Joint saw as in Lesson 17.
3. Determine the amount of set necessary.

NOTE.—Less set is needed for dry wood than for green lumber.

4. Set as in lesson 17.

Questions:

1. What two methods are used to set saws?
2. Is the method of jointing the crosscut saw any different from that of the ripsaw?
3. What will result if the saw is not jointed?
4. What method may be used to set a saw other than to use a saw set?
5. What determines the amount of set to be given the saw?
6. Are such saws as back saws and keyhole saws given any set?

Lesson 20.—To file a crosscut handsaw

Reference:

Simonds, How to File a Handsaw.
Disston's Saw Charts.

Practice:

1. Clamp saw in vise and select the file suitable for the saw.
2. Determine the angles for filing the cutting edge of the teeth.

NOTE.—The cutting edge will vary from about 65 degrees in the crosscut saw to 90 degrees in the rip saw. This angle is measured from an imaginary line drawn along the points. The tooth will also have an angle measured from the side of the saw. This will vary from 60 degrees in the crosscut saw to 90 degrees in the rip saw.

3. Hold the file at the proper angle with the handle slightly lowered.
4. File every other tooth and reverse as in filing the rip saw.

NOTE.—Extreme care will have to be exercised and the work will have to be performed very slowly in order to file all teeth the same.

5. Side joint as in the rip saw.
6. Test by sawing block of wood and note whether the saw runs evenly and cuts smooth.

Questions:

1. How does the cutting action of the crosscut saw differ from that of a rip saw?
2. How does this cutting action govern the shape of the teeth?
3. What is the difference between the cutting angle of the rip saw tooth and that of the crosscut saw tooth?
4. Why is the handle of the file dropped lower when filing a crosscut than when filing a rip saw?
5. What will be the result if the teeth are not filed the same size?
6. Why will the rip saw not cut well across the grain?
7. What kind of files are used to file saws?

Rehabilitation monograph. Joint Series No. 42

Unit Course—Physical Education 3—Graded Exercises for Cardiovascular Cases

PHYSICAL EDUCATION

February, 1919—Trial edition

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GRADED EXERCISES FOR CARDIOVASCULAR CASES

1. FOR WHOM INTENDED

These exercises are intended for use with men suffering from cardiac disturbances, either functional or organic. Many of these are the result of increased physical or nerve strain upon organs, which though able to stand up under the duties of civilian life, if some care was exercised, have broken down under the strain of the training camp or battle field.

The exercise treatment is given in connection with the medical treatment of the cardiovascular staff, including periodical examination, assignment to proper grades and observation of reaction of the patient to the treatment.

2. ADVANTAGES TO BE DERIVED BY THE PATIENT

General.—(a) The feeling of improved well-being, the result of general improvement in health and strength, circulation, respiration, digestion, and elimination having been improved through general exercises.

(b) Increase in muscular strength.

(c) Improved coordination and poise.

(d) Greater self-confidence resulting from a realization of his ability to do some physical work.

Special.—(a) Improved tone or strength of the cardiac muscle, firmness taking the place of flabbiness (the slack gathered in).

(b) Improved innervation (better nerve control of the heart action).

3. THE SELECTION OF EXERCISES

General.—Each lesson contains exercises for all the large muscle groups of the body, the purpose being general physical improvement. The condition of the voluntary muscles is frequently a criterion of that of the heart muscle.

Special.—The arrangement is that of six grades in rather definite dosage, the length of period and the vigor increasing from grade to grade. This is especially true of the exercises using the large muscle groups of the legs and trunk, as marching, running, trunk bending, and turning.

Recreational.—(a) Beginning in grade 3 hikes are included, these being given for both physical exercise and for their recreational value. The hikes are of an informal nature, the only formality being the regular formation—column of fours—and regular cadence. Whistling of tunes and singing of songs add greatly to the spirit of the patient during these hikes and have been found very helpful.

(b) Games are begun in the fourth grade, moderately vigorous ones being used. In the fifth and sixth grades more vigorous games are employed.

4. UNITS OF EXERCISE IN EACH GRADE

Each set of exercises consists of 8 exercises or units, arranged so as to give the greatest benefit. The order of the exercises should be memorized and should not be changed.

- | | |
|--------------------------------|---------------------------------------------|
| 1. Arm, foot, leg. | 5. Same as Unit 1. |
| 2. Head, chest. | 6. Sideward trunk. |
| 3. Balancing. | 7. Jumping, hopping, running, and marching. |
| 4. Forward and backward trunk. | 8. Breathing. |

5. INSTRUCTIONS TO TEACHERS

The realization of the value of the exercises should cause the teacher to be enthusiastic. This enthusiasm he should instill into the student.

Condensed instructions

1. The teacher's attitude toward his patient should at all times be sympathetic and considerate. Only such discipline as is necessary to bring results should be demanded. A heart to heart talk emphasizing kindness and helpfulness, and appealing to the men on the basis of improved physical condition, is helpful in establishing cooperation between teacher and patient.

Allow the men to stop during an exercise if marked discomfort results. This will pass after the first few days in each grade.

Give grade 1 and 2 exercises very carefully, avoiding snappy movements.

Special attention must be given organic cases, many of which fail to progress further than the fourth grade.

2. Each exercise is to be given both left and right.

Each exercise is to be taken a few times on command, then in rhythm. Movements are to be executed accurately and with full range—complete extension, flexion, etc.

Exercising with the men stimulates them to more vigorous and accurate execution.

There should be a rest period of about 20 seconds after each exercise. Men showing marked signs of breathlessness, dizziness, or pallor, should be excused. If this occurs on two successive days, the medical officer is to be notified.

Attention should be given to objective signs rather than to subjective symptoms.

It is advisable to have a medical officer present when the exercises are being given, especially to groups of beginners.

Demonstration

1. Demonstrate each new exercise, then take it on command a few times, then in rhythm.
2. Demonstrations should be counter-like; that is, if the men are to do an exercise to their left, show it to your right.

Command

Correct execution of an exercise depends largely upon the character of the command.

Every command is divided into two parts—

1. The preparatory command: explains the movement—give it in a short precise manner.

2. The command of execution: the signal to begin. The character of the command as of the rhythm depends on the character of the movement, i. e., slow, vigorous, sharp, snappy, etc.

3. Pause: there is a pause between the two parts of the command.

Breathing exercises are taken on command or in very slow rhythm, and not more than three or four times in succession. Avoid holding the breath during any movement.

Rhythm of movements

Arm and leg movements—usually in fast rhythm.

Trunk and head movements—always in slow rhythm.

Jumping—usually in fast rhythm.

Balancing—not done in rhythm, but on count or command.

Breathing—always slow.

Compound exercise—the rhythm is that of the slow movement.

Ex.: Bend arms for thrust and raise chest. The movements of both arms and chest are slow in this exercise because chest raising is done slowly.

6. PROGRESSION OF EXERCISES

(a) A definite progression in both vigor and complexity of movement is shown from grade to grade. The exercises should, therefore, be given exactly as indicated.

(b) In the hikes the progression is made upon the basis of length of period and increased cadence. This progression is made from day to day, i. e., in grade 3 begin with five minutes and increase one minute each day. In grade 4 begin with ten minutes and increase one minute each day.

(c) The progression in the games is upon the basis of length of the period and vigor. Those games involving the large muscle groups (as in running and jumping) are among the most vigorous.

7. MODIFICATION OF EXERCISES FOR INDIVIDUAL NEEDS

(a) The patient is assigned to his grade by the medical officer, depending upon his physical condition.

(b) Where there is marked distress the patient should be allowed to rest or at least take the exercise less vigorously.

(c) In some cases it is necessary to encourage the patients. In other cases to restrain them.

(d) Although the exercises are given to groups, each patient must be considered as an individual case. Some will progress quite regularly from one grade to the next in a week's time, while others will show irregular progress. In fact, many organic cases will never advance beyond the fourth or fifth grade.

(e) An approximation of time required would be one week each for grades 1, 2, and 3 and two weeks each for grades 4, 5, and 6. The patient's promotion will depend chiefly upon his physical condition and reaction, as shown in the examinations by the medical officer.

8. TESTS TO APPLY IN DETERMINING VALUE

(a) To some degree the patient's feeling of well being, as expressed by himself, or shown in his actions, is a test, as is also his ability to take the exercise without unfavorable reactions as marked breathlessness, pallor, nervousness, or extremely vigorous heart action.

(b) The important tests are those made by the physician—blood pressure, strength, stethoscopic, X-ray, cardiographic, etc.

9. REFERENCES

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2. Clinical Disorders of the Heart Beat. Thomas Lewis. Paul B. Hoeber, New York City.
3. Disorders of the Heart and Aorta (pp. 185-194). H. O. Hirschfelder, M. D. J. B. Lippincott & Co. 1913.
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10. GRADED EXERCISES

Grade 1 (15 minutes)

1. Raise arms sideupward—1. Return—2.
2. Arms bent for thrust: Straighten arms sideward and raise chest—1. Return—2.
3. Bend arms for thrust, raise heels and raise chest—1. Return—2.
4. Hands on hips: Lower trunk $\frac{1}{2}$ forward and exhale—1. Return—2.
5. Bend arms for thrust—1. Straighten arms upward—2. Return—3-4.
6. Hands on hips: Bend trunk left—1. Return—2. Right—3-4.
7. March in place (1 minute).
8. Raise arms sideward and inhale. Lower and exhale.

Grade 2 (15 minutes)

1. Arms bent for thrust: Thrust arms forward—1. Return—2.
2. Raise heels and chest and inhale—1. Return—2.
3. Bend knees $\frac{1}{2}$ deep—1. Return—2.
4. Hands on hips: Raise chest and inhale—1. Lower trunk $\frac{1}{2}$ forward and exhale—2. Return—3-4.
5. Arms bent for thrust: Swing left leg forward—1. Return—2. Right—3-4.
6. Side stride stand: Bend trunk left sideward and raise right arm sideupward—1. Return—2. Right—3-4.
7. March in place—2 minutes.
8. Raise arms foreupward and inhale. Lower sidedownward and exhale.

Grade 3 (20 minutes)

1. Raise arms foreupward—1. Return—2. Raise arms sideupward—3. Return—4.
2. Raise arms forward—1. Move arms sideward, raise chest and inhale—2. Return—3-4.
3. Bend knees and raise arms sideward—1. Return—2.
4. Side stride stand, hands on hips: Lower trunk forward—1. Return—2.
5. Arms bent for thrust: Swing left leg sideward—1. Return—2. Right—3-4.
6. Arms bent for thrust, feet closed: Turn trunk left—1. Return—2.
7. Hike—5 to 10 minutes.
8. Raise hands front of shoulders and inhale—1. Lower and exhale—2.

Grade 4 (25 minutes)

1. Raise arms backward—1. Swing arms foreupward—2. Return—3-4.
2. Bend arms for thrust and lower head backward—1. Return—2.
3. Raise left leg forward and arms sideward—1. Return—2.
4. Side stride stand: Swing arms foreupward—1. Bend trunk forward and touch floor—2. Return—3-4.
5. Raise heels and raise arms sideupward—1. Bend knees, arms sideward—2. Return—3-4.
6. Feet closed, arms sideward: Turn trunk left—1. Return—2. Right—3-4.
7. Hike—10 to 15 minutes.
8. Hands front of shoulders: Straighten arms sideward, palms upward and inhale—1. Return—2.

Grade 5 (35 minutes)

1. Feet closed, arms bent for thrust: Turn trunk left and thrust right arm forward—1. Return—2. Right—3-4.
 2. Arms bent for thrust: Straighten arms sideward, palms up, raise chest and inhale—1. Return—2.
 3. Raise arms sideward and left leg forward—1. Move left leg backward and lower trunk $\frac{1}{2}$ forward—2. Return—3-4.
 4. Hands front of shoulders: Lower trunk $\frac{1}{2}$ forward and exhale—1. Raise trunk, raise arms sideward and inhale—2.
 5. Arms bent for thrust: Lunge left sideward and thrust sideward—1. Return—2. Right—3-4.
 6. Hands on hips. Turn trunk left—1. Bend trunk forward—2. Return—3-4.
 7. Run in place 20 seconds. Breathing exercise. Repeat the run.
 8. Raise arm foreupward and inhale. Lower sidedownward and exhale.
- Free exercises, 25 minutes.
Game (moderately vigorous), 10 minutes.

Grade 6 (60 minutes)

1. Bend arms for thrust and place left foot backinward—1. Lunge left sideward and thrust arms sideward—2. Return—3-4.
 2. Step left forward, raise arms sideward, raise chest and inhale—1. Return—2.
 3. Raise left leg backwards, hands front of shoulders—1. Lower trunk forward and arms sideward—2. Return—3-4.
 4. Lunge left sideward and bend arms for thrust—1. Thrust arms sideward and lower trunk forward—2. Return—3-4.
 5. Bend knees and place hands on floor—1. Support lying frontways—2. Bend arms—3. Return—4-5-6.
 6. Side stride stand, hands on hips: Bend trunk forward—1. Circle left—2. Backward—3. Right—4. Forward—5. Raise trunk—6.
 7. Run in place—1 minute.
 8. Raise arms foreupward and inhale. Lower sidedownward and exhale.
- Free exercises, 20 minutes.
Game, vigorous, 15 minutes.
Hike, 20 minutes.

In grades 1 to 4 give exercises as indicated, once in the morning and once in the afternoon, preferably at least an hour after breakfast and at least an hour before the evening meal. In grades 5 and 6, give the exercises as indicated in the morning, but in the afternoon omit the game and give a hike of 10 to 15 minutes.

11. FREE EXERCISE POSITIONS

Head erect and chest raised in all positions

Arms forward—Arms straight, the hands shoulder high and shoulder width apart, palms inward, shoulders back.

Arms foreupward—The arms are raised upward by passing through the forward position.

Arms sideward—Arms shoulder high, hands slightly behind a line drawn through the shoulders, palms downward.

Arms sideupward—The arms are raised sideward, then the palms are turned inward as the arms are raised upward.

Arms backward—Arms raised as far back as possible, chest raised.

Hands on hips—Hands rest firmly on the hips, thumbs to the rear, elbows and shoulders back.

Hands front of shoulders—Palm downward, wrists straight, elbows shoulder high and well back.

Arms bent for thrust—Arms bent, elbows close to sides, forearms vertical, hands clenched at side of shoulders, knuckles outward.

Arms bent for strike—Hands clenched over shoulders, knuckles to the rear, elbows shoulder high and well back.

Support lying frontways—Weight supported on hands and toes, arms, trunk and legs straight.

Trunk bent forward—Back bent as much as possible, head up, knees straight. The head leads in the return movement.

Trunk lowered $\frac{1}{2}$ forward. Back flat, head up, trunk midway between vertical and horizontal positions.

Trunk lowered forward—Back flat, head up, trunk horizontal.

Trunk bent sideward—Body bent directly sideward, knees straight, feet flat on the floor.

Trunk turned—The body turned to the side named, knees straight, feet flat on the floor.

Chest raised—The chin drawn in and the chest raised upward and forward.

Heels raised—Heels raised, ankles extended, weight on toes, heels slightly separated.

Knees bent—Heels raised and slightly separated, knees bent outward, body erect, head up.

Leg raised or swung—Body erect, chest raised, leg raised as high as possible, knees and ankle extended.

Foot placed—Foot placed in given direction, toes touching floor, leg straight, weight on stationary foot. Feet about 18 inches apart.

Stride—Weight equally on both feet, feet flat on the floor. Feet about 24 inches apart.

Step—Step in given direction, weight transferred to stepping leg, heel of stationary foot raised. Distance about 24 inches.

Lunge—Leg raised and a step taken in given direction, knee of stepping leg bent, feet flat on the floor, body erect. Distance, 24 inches.

Feet closed—Inner edges of feet together, knees pressed together.

Head lowered backward—Chin drawn in, head and neck lowered backward as a unit.

12. SUGGESTED LIST OF GAMES AND EVENTS

Grade 4 (5 and 6):

Games—

Shooting baskets.

Dumbell tag.

Quoits.

Croquet.

Catch the cane.

Number ball.

Animals blind man's buff.

Pass ball relay (omit running).

Events—

Basket ball, baseball, and medicine-ball throw.

Batting.

Hurl ball.

Gymnasium apparatus—

Arm machine.

Pulley weights.

Stall bars.

Grade 5 (and 6):

Games—

Baseball.

Battle ball.

Beadle (whip tag).

Stride ball relay.

Soccer.

Tag games.

Three-deep.

Volley ball.

Jump the shot.

Bowling.

Grade 5 (and 6):

Games—Continued.

End, corner, captain ball.

Rider ball.

Events—

Chinning.

Climbing.

Medicine-ball exercises.

Paddling.

Rowing.

Shot put.

Gymnasium apparatus (with care)—

Flying rings.

Horizontal bar.

Hitch and kick.

Ladders.

Buck.

Grade 6:

Games—

Poison.

Dodge ball.

Cage ball.

Push ball.

Tennis.

Black and white.

Events—

Fence vault.

Hand wrestle.

Jumping rope (with care).

Swimming (with care).

Rehabilitation monograph—Joint Series No. 43.

Unit Course—Printing 2—Spelling and Punctuation for Printers

PRINTING

February, 1919—Trial edition

PART 1. DIRECTIONS TO INSTRUCTORS

1. QUALIFICATIONS OF THE STUDENT

This course is planned primarily for the man employed in any of the printing trades who by reason of limited education is handicapped in the use of spelling and punctuation in connection with his occupation. It will also be profitable for the author, the editor, the person in a secretarial position, the man interested in advertising, the business man, or any other person having to do with the preparation and publication of printed matter.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

The lessons in this course deal directly with the use of spelling and punctuation in connection with the printer's work. Upon completion of the course the student should have mastered the fundamental rules governing spelling and punctuation and have had sufficient practice to enable him to spell and punctuate his own production with a reasonable degree of accuracy, also to recognize errors and make corrections for the same. The lessons are intended to be of particular value to the compositor, proof reader or copyholder, or to persons desiring to prepare for either of these occupations.

3. LENGTH OF THE COURSE

This unit course is divided into 22 lessons, each of which should be completed by the student in about one hour. The time will of course vary according to the ability of the pupil to learn.

4. EQUIPMENT REQUIRED

Paper and pencils.

Textbooks:

Punctuation. F. Horace Teall. D. Appleton & Co., New York.....	\$1. 04
135,000 Words. John N. Bechtel. George W. Jacobs & Co., Philadelphia.....	1. 63
Progressive Exercises in Typography, by Loomis. Taylor-Holden Co., Springfield, Mass.....	1. 00
The New-Method Speller. Sadler. H. M. Rowe Co., Baltimore, Md.....	. 36

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers, under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

For this course the student's record can be determined by the number of words spelled correctly and the application and assimilation of the rules as stated.

The words are given in groups of either 10 or 20, and thus can readily be marked on a percentage scale. The answers given to the questions on the rules may also be based on the same system.

6. OUTLINE OF LESSONS

- I. Hyphenization (words that may properly be divided; words that should not be divided).
- II. Hyphenization (division before one of the Anglo-Saxon suffixes; two consonants separately pronounced belong in different syllables).
- III. Hyphenization (when a short vowel is followed by a single consonant or digraph the consonant is included in the syllable words with Latin and Greek terminations).
- IV. Hyphenization (division of verbs; division of legal terms).
- V. Hyphenization (division of words having short affixes and suffixes; division of words containing double consonants).
- VI. Hyphenization (words that will admit of two separations; compound words should be divided between elements of the compound; division of proper names and dates).
- VII. Compound words—general principles.
- VIII. Compound words that are joined with and without hyphens.
- IX. Compound words that require a hyphen.
- X. Capitalization—general principles.
- XI. Use of the comma.
- XII. Use of the semicolon.
- XIII. Use of the colon.
- XIV. Use of the period.
- XV. Use of the dash.
- XVI. The use of the interrogation.
- XVII. The use of the exclamation mark.
- XVIII. The use of the apostrophe.
- XIX. The use of the parentheses.
- XX. The use of brackets.
- XXI. Use of quotation marks.
- XXII. Use of reference marks.

7. SUGGESTIONS TO TEACHERS

To give the student the most benefit from the following lessons he should proceed thus: After he has studied and understands the rules, the words under each rule should be given him to spell. If no words are given under the rules, he should be given such words to spell as are indicated in the instruction sheets. He should divide the words according to the best rules of syllabication that apply to the work of printers.

The best spellers are those who learn to spell, not by rule but by sight. The English language is made up of so many irregularities in spelling, and so many words of a given sound are spelled differently and have such different meaning, that to commit all of the rules for spelling would result in confusion.

It would be well to select from the New-Method Speller and the dictionary words that are commonly misspelled and have the student write and spell these lists until he is perfectly familiar with them.

Select lists of homophones found in New-Method Speller, pages 72–80. Have the student learn to spell all of them and know what they mean and how to use them properly in printing.

The student should write compositions using unusual words and no repetition of same words. Direct him to pay strict attention to punctuation, capitalization, and hyphenization.

A large selection of sentences should be gathered by the teacher which exemplify the use and misuse of the marks of punctuation.

Selections of printed or typewritten matter should be given to the student to punctuate.

PROPOSED UNIT COURSES IN PRINTING

(Revision of December 11, 1918)

Unit course No.	Unit course No.
1. Basic unit course in elementary composition for beginners. ¹	18. Freehand lettering.
2. Punctuation and spelling. ¹	19. Color harmony.
3. Proof reading. ¹	20. Advertising composition.
4. Study of type faces—extension unit course, 20 hours.	21. Tabular composition.
5. Principles of design in printing—extension unit course, 20 hours.	22. Printers' materials—paper.
6. Job composition—extension unit course, 20 hours.	23. Printers' materials—ink.
7. Advanced job composition.	24. Linotype operation—30 hours.
8-15. Book composition—eight unit courses.	25. Monotype operation.
16. Imposition and stone work.	26. Cost accounting.
17. Technical terms.	27. Estimating.
	28. Stock cutting.
	29. Multigraph printing.
	30. Multicolor printing.

PART 2.—STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

LESSON I.—HYPHENIZATION

(Words that may properly be divided; words that should not be divided)

- (a) Generally speaking, words are broken in printing as they are divided in speaking.
 (b) In ordinary book and newspaper composition the typographer divides no word in the line, except in some cases the last, unless he encounters a chance hyphenated compound. The following are examples:

1. red-hot.	8. type-high.	15. fog-bell.
2. native-born.	9. needle-point.	16. hell-diver.
3. well-known.	10. case-harden.	17. mop-wringer.
4. hand-sewed.	11. deaf-mute.	18. office-seeker.
5. sky-high.	12. dead-wood.	19. road-roller.
6. fancy-free.	13. desk-room.	20. salt-spring.
7. down-stairs.	14. dip-net.	

(c) Words of one syllable, even though they may be long, should never be divided in printing—as through, ground, height.

(d) Short words of two syllables are never divided—as into, upon, fasten, given, after, soften, eleven, heaven, listen, prayer, moisten.

(e) When two consonants meet between two vowels, the division is generally made between the consonants.

Examples

1. Con-sonants.	8. ter-restrial.	15. var-nish.
2. com-mon.	9. ton-sil.	16. quar-rel.
3. com-pounding.	10. ver-nacular.	17. com-pete.
4. in-sinuate.	11. Wednes-day.	18. sec-tion.
5. sal-vation.	12. com-mo-dity.	19. pen-sion.
6. sor-did.	13. cul-minate.	20. car-nation.
7. ten-sion.	14. embel-lish.	

¹ Already prepared.

(Study such words in Bechtel and in New-Method Speller)

(f) When the final consonant is doubled on taking a suffix, the separation occurs between the consonants—as admit-ted, concur-rence; but if a double consonant ends the stem the consonants are not divided—as add-ing, ebb-ing, call-ing, spell-ing. (Read Teall, pp. 69-71.)

Questions

1. What is the general rule for typographers with regard to division of words?
2. Why should we not divide words like—thesis, thirty, dipper, tidal, vary, alley, anger, daisy.
3. Give examples of words which double the final consonant when taking a suffix. How should such words be divided?
4. When two consonants meet between two vowels in a word, how should the word be divided?
5. How should the following words be divided?

1. composition.	6. expensive.	11. convenient.
2. enlarged.	7. consequent.	12. discussion.
3. development.	8. combination.	13. suggestion.
4. paragraph.	9. collecting.	14. expressions.
5. exercises.	10. brilliance.	15. transition.

LESSON II.—HYPHENIZATION

(Division before one of the Anglo-Saxon suffixes. Two consonants separately pronounced belong in different syllables)

Rule 1. In dividing before one of the Anglo-Saxon suffixes—ed, ing, er—do not take over a consonant with the suffix, even when the preceding vowel is long, unless a final consonant is doubled, as—

1. danc-ing.	8. assum-ing.	15. bid-ding.
2. cring-ing.	9. baptiz-ing.	16. sing-ing.
3. dwell-ing.	10. count-ing.	17. young-er.
4. smell-ing.	11. partak-ing.	18. fing-er.
5. scan-ning.	12. hat-ter.	19. ring-ing.
6. win-ning.	13. pot-ter.	20. preced-ed.
7. bak-ing.	14. conniv-ed.	

Rule 2. Two consonants separately pronounced belong in different syllables, as—

1. satisfac-tory.	8. biog-raphy.	15. bot-tle.
2. neces-sary.	9. trium-phant.	16. trick-le.
3. bril-liant.	10. deg-radation.	17. prac-tical.
4. drunk-ard.	11. scrip-ture.	18. admit-ted.
5. bus-tling.	12. adjec-tive.	19. hun-dred.
6. his-tory.	13. con-tinue.	20. les-son.
7. pam-phlet.	14. ear-nest.	

Questions

1. What are four of the Anglo-Saxon suffixes and how are words divided that contain them?
2. How should the following be divided:

1. surgery.	5. symptom.	9. furniture.
2. magnolia.	6. eighteen.	10. haddock.
3. suspension.	7. emboss.	
4. synonym.	8. elephant.	

(Read Teall, pp. 72-73.)

LESSON III—HYPHENIZATION

(When a short vowel is followed by a single consonant or digraph, the consonant is included in the syllable words with Latin and Greek terminations)

Rule 3. When a short vowel is followed by a single consonant or digraph, the consonant is included in the syllable with it; as,

- | | | |
|------------------|----------------|---------------|
| 1. pat-ent. | 5. sep-arate. | 9. prob-able. |
| 2. pal-ace. | 6. pre-judice. | 10. pal-ate. |
| 3. compar-ative. | 7. ma-gic. | |
| 4. graph-ic. | 8. fa-cile. | |

(Read Bechtel, pp. 37-41.)

Rule 4. Words with Latin or Greek termination should be divided according to sound, as—

- | | | |
|-----------------|--------------------|-----------------|
| 1. classi-cal. | 8. impor-tance. | 15. dispu-tant. |
| 2. practi-cal. | 9. comfor-table. | 16. disput-ed. |
| 3. albumi-nous. | 10. disjunc-tive. | 17. recit-ed. |
| 4. assis-tant. | 11. deba-ting. | 18. recit-al. |
| 5. detec-tive. | 12. contribu-ting. | 19. repu-table. |
| 6. termi-nal. | 13. anticipa-ted. | 20. dot-ish. |
| 7. agita-ted. | 14. illustra-ted. | |

(Read Teall, pp. 76-85.)

Questions

1. What is a digraph?
2. Point out digraph in the following words.
3. Divide each of the following words:

- | | | |
|----------------|---------------|-----------------|
| 1. epitaph. | 8. pseudonym. | 15. aeolian. |
| 2. phosgene. | 9. appear. | 16. aeroplane. |
| 3. diphtheria. | 10. freight. | 17. aesthetic. |
| 4. monarchy. | 11. Caesar. | 18. aerodrome. |
| 5. phenomenon. | 12. surfeit. | 19. aesophagus. |
| 6. photograph. | 13. mullein. | |
| 7. typography. | 14. honey. | |

LESSON IV—HYPHENIZATION

(Division of verbs; division of legal terms)

Rule 5. When verbs end in silent "e," the "e" is dropped in taking the suffix—ed, er, ing; and in dividing such words the consonant remains with the stem when the accent remains unchanged—as dat-ed, bit-ing, adher-ing. But when the accent is changed and falls on the penult or antepenult the consonant goes over with the ending—as incompa-rable, conso-nant.

Rule 6. Learn these divisions, but use them only when absolutely necessary. It is rarely necessary except in composition set in large type and in unusually narrow measure.

- | | | |
|----------------|-----------------|----------------|
| 1. lega-tee. | 4. do-nor. | 7. consign-ee. |
| 2. les-see. | 5. guaran-teed. | 8. grant-ee. |
| 3. mortga-gee. | 6. assign-ee. | |

Questions

1. What is the penult? (Syllable preceding final one.)
2. What is the antepenult? (Last syllable but two.)

LESSON V—HYPHENIZATION

(Division of words having short affixes and suffixes; division of words containing double consonants)

Rule 7. Short affixes and suffixes; as, in-, en-, ex-, ad-, af-, on-, de-, and -al, -an, -on, -ly, should not be separated from the stem in good type composition; as

1. enhance.	8. onward.	15. slaked.
2. engulf.	9. only.	16. looked.
3. explain.	10. delay.	17. tacked.
4. advance.	11. deny.	18. fitter.
5. intake.	12. destroy.	19. gladder.
6. affirm.	13. royal.	20. patter.
7. after.	14. loyal.	

Rule 8. It is not good type composition, although it is grammatically correct, to separate suffixes when preceded by a double consonant—as combatted, gladdest.

Questions

1. Why should not the majority of the words listed above be divided?
2. What can you say about dividing such words as:

1. stopped.	4. chopped.
2. dropped.	5. clapped.
3. blurred.	

(Study such words found in the New-Method Speller.)

LESSON VI—HYPHENIZATION

(Words that will admit of two separations; compound words should be divided between elements of the compound; division of proper names and dates)

Rule 9. Words that will admit of two separations; but both kinds should not be used in the same paragraph. The first column given below is preferred.

1	2
1. trou-ble.	troub-le.
2. buc-kle.	buck-le.
3. reli-gion.	relig-ion.
4. dis-infect.	disin-fect.
5. dis-organize.	disor-ganize.
6. dis-avow.	disa-vow.
7. dis-agreed.	disa-greed.
8. in-humanity.	inhu-manity.
9. un-able.	una-ble.
10. service-able.	servicea-ble.

Rule 10. Compound words, whether hyphenated or solid, should be divided between the elements of the compound: as

1. twenty-one.	5. barley-corn.	9. fish-monger.
2. ginger-bread.	6. button-hole.	10. musk-melon.
3. book-keeping.	7. dress-making.	
4. butter-milk.	8. fire-cracker.	

Rule 11. Proper names should not be divided in any case. Dates must not be divided. Large numbers may be divided at the separation of the three figure groups—as 556,786,-657. A number consisting of less than six figures should not be divided.

Questions and exercises

1. How should "fortytwo" be divided?
2. How should "fireman" be divided?
3. Write ten compounds using the hyphen.
4. Write ten compounds using no hyphen.

LESSON VII—COMPOUND WORDS

(General principles)

Two words used without inherent grammatical relation are properly a grammatical unit, and should be joined in a compound in writing.

Words so associated as to conform separately to real grammatical classification should not be compounded unless their joint application is arbitrary.

Two nouns used together as one name in such a way that the first does not convey a descriptive or attributive sense, or so that the two are not in apposition, form a compound noun and are joined with a hyphen.

(Study such list of words in Teall, p. 89.)

A rule for the use of the hyphen can not be definitely settled, as the use of the word has determined that to a very large extent. The safest way is to study compound words from an up-to-date dictionary or other authentic sources.

(Study list of such words in Teall, pp. 91-99.)

Exercise

1. Write ten compound words which must have hyphen.

LESSON VIII—COMPOUND WORDS THAT ARE JOINED WITH AND WITHOUT HYPHENS

When a compound is made up of two words which together form a name necessary to the object they are joined without a hyphen, as—

- | | |
|----------------|--------------|
| 1. cottonwood. | 6. bluefish |
| 2. matchlock. | 7. dogfish. |
| 3. woodpecker. | 8. weakfish. |
| 4. thumbscrew. | 9. footboy. |
| 5. pintail. | 10. areaway. |

Compound words made up of two words one of which has more than one syllable usually require a hyphen, as—

- | | |
|------------------|-----------------|
| 1. adder-fish. | 4. ribbon-fish. |
| 2. devil-fish. | 5. weaver-bird. |
| 3. humming-bird. | |

Any two words used in arbitrary association as a single name are compound nouns, as—

- | | |
|-----------------|----------------|
| 1. grandfather. | 4. drawbridge. |
| 2. waterproof. | 5. wide-awake. |
| 3. pickpocket. | |

Exercises

1. Write five compound words which should not have the hyphen.
2. Write five compound words that require a hyphen.

LESSON IX—COMPOUND WORDS THAT REQUIRE A HYPHEN

Two or more words in arbitrary construction or in such connection that they would be misunderstood if left apart, are compounded with a hyphen, as—

- | | |
|----------------|-------------------|
| 1. red-hot. | 6. knee-deep. |
| 2. hand-sewed. | 7. fancy-free. |
| 3. ill-bred. | 8. native-born. |
| 4. type-high. | 9. black-faced. |
| 5. sky-high. | 10. block-headed. |

(Read and study Teall, pp. 100-106; Bechtel, pp. 78-79.)

Exercises

Write 10 words of arbitrary construction that must be compounded with a hyphen.

LESSON X—GENERAL PRINCIPLES—CAPITALIZATION

Learn the following:

Rule 1. Every sentence must begin with a capital letter.

Rule 2. Every line in poetry must begin with a capital.

Rule 3. Every proper name must be capitalized.

Rule 4. Every word derived from a proper name, unless it has lost its identity, should be capitalized—as Congressional, Senatorial.

Rule 5. All appellatives of God should be capitalized.

Rule 6. All titles of military, corporation, society, political, and judicial officers, except those of most inferior rank, have capital letters.

Rule 7. Pronoun I and interjection O always are written in capital letters.

(Read Teall, pp. 109–123.)

Exercises

Correct the following:

1. when a sentence contains such words as god, general, judge what can you say about the capital letters that should be used in the sentence.
2. general pershing went to france in charge of the american expeditionary forces.
3. i was so sure, o, so sure, that the germans would be beaten.

LESSON XI—USE OF THE COMMA

Where there is a slight break in the connection of the grammatical construction of a sentence, the comma is used.

(Study Teall, pp. 1–15 inclusive.)

Examples

1. Red, white, and blue are the national colors of the United States.
2. John, bring me that pencil.
3. The car was tearing, shooting down the street.
4. The soldier, although he was rather small, was one of the best fighters.
5. Soldiers, therefore, cannot be judged from appearances.

Exercises

Correct the following sentences with regard to capitalization and use of marks of punctuation:

1. benjamin franklin made a very humble first entrance into philadelphia dirty from his long journey in working clothes his pocket stuffed out with shirts and stockings and with a loaf of bread under his arm
2. the majority of the people would be better off if they had more money and spent it
3. john smith who has been living in france for many years has now returned to the united states
4. the farmer brought apples pears peaches and potatoes to market

LESSON XII—USE OF THE SEMICOLON

When there is a break in the sentence such that a comma will not be sufficient to represent it, a semicolon is used.—

(Study Teall, pp. 16–21; Bechtel, pp. 88–90.)

Examples

1. Soldiers must learn to shoot, and to shoot quickly and accurately; for the good marksman is the most valuable man in the army.
2. At the annual meeting of the Yale Club the following officers were elected: Arthur Stillwell, President; Frank Rice, Vice-President; and John Anderson, Secretary-Treasurer.
3. Victory is won; the war is over; the boys will soon be home.

Exercises

Correct the following sentences with regard to capitalization and punctuation:

1. we might as well end this war with victory now for if we don't we never shall have permanent peace

2. as caesar loved me i weep for him as he was fortunate i rejoice at it as he was valiant i honor him but as he was ambitious i slew him.

Shakespeare.

3. when cold weather comes we must eat more exercise more dress in warmer clothes especially those made of wool.

4. there were three transports that docked at hoboken today the lusitania from london the george washington from liverpool and the orduna from bordeaux

5. in citizens clothes soldiers seem to be of many sizes and to vary greatly in general appearance but when they get on khaki and march in columns their individuality is obscured

LESSON XIII—USE OF THE COLON

The greater divisions of a sentence are separated by colons; the less noticeable ones by semicolons; and the least by commas:

(Study Teall, pp. 22-25; Bechtel, pp. 90-91.)

Examples

1. Those present at the reception were: Mrs. Adam White, Mrs. Charles Smith, and, etc.
2. Dear Sir:
3. Strive to earn money: it will bring you happiness.

Exercises

Correct the following sentences with regard to capitalization and punctuation:

1. the following members of the round table club were asked to speak mrs alexander roundface of grass valley cal miss laurette longface of heartless gap iowa the baking powder twins of powder puff point and jonathan anglefoot of anglesea n. j.
2. it is cold today the snow is white and clean and piles before the swirling wind we shall wait a few days before we go fishing again
3. rules for the use of marks are many to commit them would be folly if that were as far as you went understand when and how to apply them.
4. dear john
the day is bright and shining and i will soon be home
5. it makes no difference how some people save and scrimp and work they never can get a bank account

LESSON XIV—USE OF THE PERIOD

A period should follow every declarative and imperative sentence and every abbreviation. It is used before a decimal number.

(Read Teall, pp. 26-33; Bechtel, p. 92.)

Examples

1. A period ends an ordinary sentence.
2. Use a period between dollars and cents, as \$4.80.
3. A period should be placed after all abbreviations, as, p. m., a. m., Gen. and Capt.
4. A period should follow initials, as, C. A. Barnes, Esq.

Exercises

Correct the following sentences with regard to the use of capital letters and punctuation marks:

1. the rules for the use of capital letters are many but they are much more definite than those for marks of punctuation it seems as if many authors constituted authority but when authors disagree it leaves a poor young fish of a writer in shallow water where he may easily be speared by the unkind public
2. some authors may put a period between nine and fifteen when it is that hour instead of a colon for my part it would look like nine dollars and fifteen cents then how about you

3. most of us know where to put a period anyhow even if we don't evidence the knowledge in practice
4. the little boy was correct when he abbreviated ante meridian a m
5. lb for pound qt for quart doz for dozen gen for general are some of the typical and most common abbreviations

LESSON XV.—USE OF THE DASH

A sudden break in a statement is usually marked by a dash.
(Read Bechtel, pp. 92-94; Teall, pp. 41-47.)

Examples

1. When the sentence ends in the line—not at the end of the line—it should be followed by an em quad.
2. Dash is used when part of a date is omitted, as 18—, 1896—99.

Exercises

Correct the following sentences with regard to the use of capital letters and marks of punctuation:

1. the dash is a mark of punctuation often abused seldom used correctly when writer is in a hurry
2. in the streams of the adirondacks trout are very abundant they almost jump at you they are so plentiful
3. in the streams of new jersey the sluggish passaic for instance how many trout are there none
4. he started to sing as he tackled the thing that couldn't be done and he did it
5. i saw upturned trees broken fences and buildings all evidences of the fierceness of the storm

LESSON XVI.—THE USE OF THE INTERROGATION

When a question is asked it should be followed by an interrogation mark.
(Read Teall, pp. 34-39; Bechtel, p. 94.)

Examples

1. When shall we be leaving this camp?
2. When there is some doubt about the truth of a statement the interrogation mark is put in parentheses near the statement.
The great General was shot and killed near Metz (?) in the last battle.

Exercises

Insert marks of punctuation and correct capitalization in the following sentences:

1. why does one slip on a banana skin
2. the dog barks angrily does he bite
3. where do we go from here
4. have you studied all the rules of punctuation
5. did you know that an aviator can see fifty feet below the surface of water

LESSON XVII.—THE USE OF THE EXCLAMATION MARK

When emotion, surprise, admiration, or contempt are expressed, an exclamation point ends the sentence.

(Read Bechtel, p. 95; Teall, pp. 34-40.)

Examples

1. John, shoot quick!
2. Look! There goes the aeroplane!
3. The Boche, the yellow cur!
4. Oh! You frightened me!
5. Oh! My head! How it aches!

Exercises

Correct the following sentences:

1. break break break
on thy cold gray stones o sea—Tennyson.
2. run quick the fire is coming
3. a horse a horse my kingdom for a horse
4. good heavens he said where is my sister
5. look how swiftly the aeroplane flies

LESSON XVIII.—THE USE OF THE APOSTROPHE

The apostrophe is used to denote possession and in contractions.
(Read Bechtel, p. 96; Teall, pp. 54–59.)

Examples

1. A soldier's uniform is khaki color.
2. Don't make mistakes.
3. Sec'y. Lansing.
4. I have five f's and ten 10's.

Exercises

Correct the following sentences:

1. the boy had a pocket full of 1s and 2s and felt like a millionaire
2. if you wont use marks of punctuation correctly then it is not because you cant
3. the girls hair is yellow and her eyes are blue
4. —thou hast contrivd against the very life
of the defendant, and thou hast incurrd
the danger formerly by me rehearsed
down therefore, and beg mercy of the duke

—Shakespeare.

5. slang is objectionable because it is used by the lowest classes it is inelegant and limits ones vocabulary.

LESSON XIX.—THE USE OF THE PARENTHESES

When words or phrases are introduced for explanation in the sentence, they are inclosed in parentheses.

(Read Bechtel, pp. 96–97; Teall, pp. 48–52.)

Examples

1. The modern machine gun (the new Browning) is the most effective weapon of great war.
2. The great French General (Joffre) visited the United States during the war.

Exercises

Insert punctuation in the following sentences:

1. Parentheses are used see example 6 when something foreign is inserted.
2. I the writer think that you have given the correct rule.
3. The speaker a white bearded old man was intensely interesting.
4. The after dinner speaker because of his many parenthetical insertions sometimes is very uninteresting.
5. The train the Black Diamond Express was seldom late.

LESSON XX.—THE USE OF BRACKETS

When words or phrases are inserted which do not have any effect on the meaning of the sentence they should be inclosed within brackets.

(Read Teall, pp. 52–53.)

1. A person may be quoting from a letter, and use only part of the quotation: the omission is simply noted, but is not explanatory of the content: as,

"If you are coming home by the B. R. T., mentioning articles to be brought, you will be taking your life in your hands."

2. When one parenthetical expression occurs inside another the brackets inclose the inner one; as in an algebraic expression.

$$3x - (5a + [6b - 3x] - 5b + 17b)$$

Exercises

Insert the punctuation in the following sentences:

1. Were you in the automobile at the time of the wreck?
2. He said you and me I were to go.
3. Religion who can doubt it is the noblest theme for contemplation.
4. The smile of a child always so ready when there is no distress, and so soon returning when the distress has passed, is like an opening in the sky showing heaven beyond.

LESSON XXI—USE OF QUOTATION MARKS

When the exact words of another man are used in a sentence, they are separated by quotation marks.

(Read Bechtel, p. 97; Teall, pp. 59-61.)

1. John said, "I am going home."
2. A quotation within a quotation is enclosed in single marks instead of double. These quotations occur in the Bible frequently. The following taken from Teall, "Punctuation":
"In the New Testament we have the following words: 'Jesus answered the Jews, "Is it not written in your law—"I said, "Ye are gods" ' ? ' ' ' "

Exercises

Insert the punctuation in the following sentences:


1. John said after he had deposited his hat and coat I am home again and am mighty glad to be here.
2. Oh mary she cried why have you been so long in getting here
3. Come here the officer commanded I need you
4. When do we leave for home was the question of nearly every boy
5. As soon as you are able was the reply.

LESSON XXII—USE OF REFERENCE MARKS

1. * Asterisk, or star.
2. † Obelisk, or dagger.
3. ‡ Double obelisk, or double dagger.
4. § Section.
5. || Parallel.
6. ¶ Paragraph.

When explanatory notes are put at bottom of the page, the reference marks are used in above order. When more than six notes are necessary, the marks are doubled.

(Read Teall, pp. 62-68.)

The index, or fist,  is used where special emphasis or attention should be called to a certain expression or word.

Rehabilitation monograph. Joint Series No. 44.

Unit Course—Printing 3—Proof Reading

PRINTING

February, 1919—Trial edition

INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is designed for the man who has had some experience in printing and publishing either as a country printer, a city printer with general experience, an author, editor, or advertising manager, and who wishes to become proficient in proof reading.

To be successful as a proof reader, a good education is essential, particularly in English. A knowledge of foreign languages is an advantage. Certain physical qualifications must also be considered. The work is trying on the eyes, and a person with weak or defective eyes should not be encouraged to take up proof reading as a vocation. A man's nervous condition might prevent him from being successful as a proof reader, as he would be subjected to long hours of trying work under rush conditions. To be a good copy reader or assistant to the proof reader, he must be able to read well and rapidly and to articulate clearly and pleasantly.

It is recommended that the student, unless he is very well educated, complete Unit Course Printing 2, "Spelling and punctuation," before he takes up "Proof reading."

2. LENGTH OF THE COURSE

The work outlined is intended to cover about 30 hours of instruction and practice by the student.

3. CHARACTER OF LESSONS

The course of lessons recommended for the student is entitled "Exercises in Proof Reading," by Adele Millicent Smith, published by the John C. Winston Co., Philadelphia, Pa. Price 50 cents per set. This includes 15 exercises in proof reading, which are designed to give the student practice in reading and marking the various common types of proof sheets and typographical errors.

The exercises are put up in three sets, one set with errors for the student to correct, the second set showing the errors corrected for comparison with the student's corrected sheets and the third set showing the perfect printed copy.

4. SUGGESTIONS FOR TEACHING

Thorough explanation of the different proof readers' marks should first be given to the student. He should then learn the rules given in his introductory lesson sheet. Then he may proceed with the exercises in proof reading.

In using these exercises the teacher should give the student the lesson sheets and retain the corrected sheet. After they have been corrected by the student, the teacher should go over them and compare them with the corrected copies.

The student should be given the corrected proof sheets first so that he may study the method of using the proof reader's marks, which will also show him how keen he must be to discover errors in printing.

It would be well, also, if there is a print shop in connection with the institution in which the student is being trained, to get proofs of the work done in this shop and correct them. This would make the work more practical.

Special attention and drill must be given to the division of words and correct syllabication. Reference to the Unit Course "Spelling and punctuation" may be used in this connection. Impress on the student that words should be divided only when positively necessary. Also that short words of two syllables never should be divided.

The teacher should thoroughly study the course "Spelling and punctuation," so that he may explain the marks of punctuation in regard to their use in proof reading. Especially should he be familiar with the subject of syllabication.

Encourage the student to read books and newspapers critically from the standpoint of a proof reader. He will notice that high-class books and magazines are more free from typographical errors than those on lighter and less educational subjects. This will possibly incline the student towards good reading.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating students' work in proof reading are available, it is recommended that final rating be recorded as follows: The average student will be rated good, the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in the commercial shop should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- (1) Execution of work:
 - (a) Time.—Is the student rapid, moderate, or slow in correcting proof?
 - (b) Technique.—Does the student use proof marks correctly?
Is he neat and orderly in correcting proof?
- (2) Finished product:
 - (a) Accuracy.—Should be determined by the record kept of errors in marking mistakes, and omissions of corrections he should have made.
 - (b) Quality.—Consider the corrected proof in other respects than accuracy, such as neatness and clearness.
 - (c) Mastery of principles.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?
- (3) Interest:
 - (a) Attitude toward work.—Does the student love his work or does he watch the clock?
Is he likely to continue in this line of work?
 - (b) Studiousness.—Does the student show disposition to study the printed literature related to this work?
Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) Possibilities of growth.—Is the student likely in due time to receive promotion to positions of greater responsibility?
- (4) Test problem.—A proof sheet might be given at the conclusion of the course which would involve all or most of the points covered by the course.

6. REFERENCE BOOKS

The instructor should direct the student to references in the various books mentioned below, and require him to study carefully certain sections that are particularly applicable to his exercises:

References for instructor:

- The Writer's Desk Book. William Dana Orcutt.
- Manual of Style. Inland Printer.
- Correct Composition. DeVinne.
- Plain Printing Types. DeVinne.
- Style Book of Typographical Practice at the University Printing Office of Columbia University. By Douglass C. McMurtrie.
- Printing as a Rehabilitation Subject for Sick and Wounded Soldiers. Frank K. Phillips, American Type Founder's Co., Jersey City, N. J.

References for student:

- Proof reading and punctuation. A. M. Smith.
- Punctuation and capitalization. Charles H. Cochrane.

PROPOSED UNIT COURSES IN PRINTING

(Revision of December 11, 1918)

Unit Course No.

1. Basic unit course in elementary composition for beginners.¹
2. Punctuation and spelling.¹
3. Proof reading.¹
4. Study of type faces—extension unit course, 20 hours.
5. Principles of design in printing—extension unit course, 20 hours.
6. Job composition—extension unit course, 20 hours.
7. Advanced job composition.
- 8-15. Book composition.
16. Imposition and stone work.
17. Technical terms.

Unit Course No.

18. Freehand lettering.
19. Color harmony.
20. Advertising composition.
21. Tabular composition.
22. Printer's materials—paper.
23. Printer's materials—ink.
24. Linotype operation—30 hours.
25. Monotype operation.
26. Cost accounting.
27. Estimating.
28. Stock cutting.
29. Multigraph printing.
30. Multicolor printing.

INTRODUCTORY LESSON

1. Learn the following rules:

A paragraph should begin as follows: The wider the measure, the more should be the indention. From 13 to 18 picas use an em-quad. From 18 to 24 use an em quad and an en quad to 2-em quad. When above 24 picas, use 3-em quad.

A paragraph should end in the the middle of the line, if possible.

Never end a paragraph with a syllable of a word. Never end a paragraph with less than an em-quad at end of the line.

2. Italic type is used for emphasis. When it is desired that a certain word should be made more prominent so that it will be more noticeable, set that word in italic. (Study Bechtel, pp. 54 to 65.)

3. Study carefully the "Explanation of proof marks" given on attached sheets.

4. Proceed with the "Exercises in proof reading" according to directions from your instructor.

¹ Already prepared.

EXPLANATION OF PROOFREADER'S MARKS

wf

Wrong font.—When a letter appears which belongs to another kind of type than that in which the type composition is set, it is called wrong font.

¶

Sign of the paragraph.—This mark is used to denote where a paragraph should begin. It is placed in front of the line that should begin the paragraph.

tr

Transposition of a letter or word.—When a letter is out of order so that the word is incorrectly spelled, this sign is used. It is also used when words are out of order, along with a line around the words, to indicate the correct position of the words.

bf

When a wavy line is drawn under a word, it means that this line should be set in bold-face type. BF is sometimes used for the same purpose.

ital

A straight line drawn under a word or words together with "*ital*" in the margin, means put them in italic type. This same marking is done in editing copy before it goes to the printer.

Caps

When three straight lines are drawn under words, they mean that these words should be set in capitals of the type used in the composition.

==

Two lines under a word mean small caps.

rom

When the compositor has made a mistake and set the copy in italic or some other type than that used in the body composition, a line around that word so set and with "*rom*" in the margin means to set the word or words in roman style of type.

" " "

When an expression is to be inclosed in quotation marks, the proof is marked with a (v) below each set of quotation marks.

lc

If a certain letter, word, or words have been set in caps, small caps, or italic, but should have been set in lower case, the accompanying mark is placed alongside the corrections.

┆

When a space or quad or possibly an inverted letter shows on the proof, a short vertical line with a small curved line under it indicates that the correction is to be made in the type.

○

A dot with a circle around it is the mark used when a period should be inserted in the type. The circle is placed around the dot so that the correction will surely be noticed and not be mistaken for a comma or possibly a spot on the paper.

...stet

If an author makes a correction in the proof and afterwards changes his mind about the correction and wishes it to stand as it was originally set or written, he makes a row of dots under the words involved and puts "*stet*" in the margin along with the correction. The word "*stet*" is of Latin derivation and means "let it stand."

9

A *curled line* such as shown is used when the compositor has set a letter or word upside down, and means for him to turn the letter over.

#ref

If a space has been left out in the type composition and it is desired that one be inserted, (#) character is put on the margin of the proof and a caret is put where the space should be inserted.

V

When an apostrophe is missing in the word in which it belongs, the correction is indicated by the *apostrophe mark* with a (v) under it to distinguish it from a comma.

,

If a comma is to be inserted, the correction is made. The place where the comma should be inserted is indicated by a caret at the spot where the comma or apostrophe should appear.

X

An "x" is made when a broken letter appears and a circle is drawn around the letter so there will be no danger of mistaking the correction.

|-|

When a hyphen should be inserted, it is made on the proof and a line is made at the right of it. This line is made thus so that the correction will not be overlooked and also to separate this correction from others that might be made for mistakes in the same line.

?OK

If the proof reader is in doubt about the correction he has made, or if he wishes to call the author's attention to some particular point about the proof to make sure that the author has expressed himself as he wished, a "?" with "OK" is placed around them on the proof.

[

When the line should be moved to a certain point to the left, a bracket is placed at that point with the opening to the right.

]

A bracket at the point where a line is to be moved to the right is used to mark that point. It should open toward the left.

C

When a space has been inserted where it should not have been and the space should be closed up, a curved line is placed above and below the correction and (#) placed on margin of the proof near the line where the mistake occurs.

|

When the ends of lines of the proof are out of line, a line is made along the ends of these lines. This unevenness is caused by spaces being put on the ends of the lines or else the lines have been improperly justified so that they are of different lengths.

)

If words are spelled in combinations of letters such that logotypes (combinations of letters cast on one body type) may be used, it is a mistake not to use them. Æ, œ, fi, fl, ffi, ffl, ff are logotypes and should always be used when words make it possible for them to be used. A curved line over the letters on the proof indicate this correction and the combination is marked in the margin of the proof sheet.

No P

When the typographer has begun his paragraph where he should not, "No" with the paragraph sign are used to indicate the correction.

Spell out

If the typographer has abbreviated a word (possibly he followed copy) that he should have spelled out, a circle is drawn around the word so abbreviated and "spell out" is placed next to that line of the proof.

Q

The mark for deletion is the "dele" and is used when a word, letter, or words are to be taken out. The word comes from the Latin word "delere," meaning to destroy.

1

When more space should be inserted between words, a caret is used at the point where this space should be.

□

When a square is put in front of a line or word, it means that an em quad should be placed there. It may mean to indent an em quad for a paragraph.

□□

Two squares would mean a two-em quad for the same purpose.

□□□

Three squares would mean a three-em quad for the same purpose.

✓✓✓✓

A number of check marks along a line between words means that spacing is uneven and should be made even.

==

When the lines of type are uneven in alignment, horizontal lines at that point denote the correction to be made.

┌

Raise word, letter, or character.

└

Lower word, letter, or character.

|¹/_{em}||²/_{em}||³/_{em}|

When a 1-em dash, 2-em dash, or 3-em dash is to be inserted, the mark is made as indicated.

Rehabilitation monograph. Joint Series No. 45.

Unit Course—Sheet-Metal Work 1—Soldering

SHEET-METAL WORK

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the student who has selected sheet-metal working as a vocation of interest to him as a trade and is intended to fit him for the sheet-metal shop or the shops of manufacturing industries where sheet metals are extensively employed. No previous experience in sheet-metal working is required, but a common-school education is desirable.

2. THE AIMS OF THE COURSE ARE—

- (1) To give a balanced practice in all of the soldering operations involved in common sheet-metal work.
- (2) To acquire skill in the use of the soldering copper.
- (3) To develop judgment by actual use in the selection, use and care of soldering tools.
- (4) To become familiar with the various kinds of metals and acids used for good soldering.

3. LENGTH OF THE COURSE

This course is intended to cover about thirty hours of instruction, study, and practical work by the student. In order to bring the course within this time the instructor will make necessary modifications or substitutions in the problems for construction by the student.

4. OUTLINE OF LESSONS

The following problems, selected as essentials for successful soldering, are suggested for this course. These problems are all worked out in Sheet Metal Workers' Manual, to which book the pages given refer. The instructor is at liberty, however, to modify the problems or substitute others according to conditions prevailing with the class and student:

- | | |
|-------------------------------------------|---------------------------------------|
| (1) Forging the soldering copper. | (4) Soldering seams. |
| (2) Tinning points of coppers. | (5) Soldering repair work. |
| (3) Preparing a flux of chloride of zinc. | (6) Stripping ornaments and patterns. |

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers, under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating are available, it is recommended that the final rating be recorded as follows:

The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

- (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
- (b) *Technique*.—Does the student use workmanlike methods?
Does he exercise reasonable economy in use of materials?
Is he neat and orderly in care of tools?

(2) Finished product:

- (a) *Accuracy*.—Should be determined by the record kept of errors, in too much or too little solder used in seams, strength of seams, etc.
- (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

(a) *Attitude toward work.*—Does the student love his work or does he watch the clock?

Is he likely to continue in this line of work?

(b) *Studiosness.*—Does the student show disposition to study the printed literature related to this work?

Does he express a desire to take advanced unit courses in this or related subjects?

(c) *Possibilities of growth.*—Is the student likely in due time to receive promotion to positions of greater responsibility?

(4) Test problem: A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

6. GENERAL SUGGESTIONS TO THE TEACHER FOR CONDUCTING THE WORK

(1) Give the class a demonstration in soldering with the pointed copper, bottom copper, and hatchet copper, pointing out the method of taking solder for small work and applying solder direct to long seams. Show how the point of the soldering copper may be used.

(2) Make a memorandum of questions where the answers are given in the lesson sheets.

(3) Have the student memorize answers to questions that the lesson sheets give for oral examination before beginning work on each problem.

(4) So that the student will become familiar with the different metals that can be soldered, give a lecture on various kinds of sheet metal. Make clear what they are and lecture on important points regarding their manufacture.

(5) If equipment is available, teach the student how to make his own acid swab from $\frac{7}{8} \times 4\frac{1}{2}$ " tin strips and cow-tail.

(6) If the school shop has the equipment, have the students make their own nontipping acid cups. Two types of nontipping acid cups are given in "Kinks," vol. 1, pp. 90-91-92.

(7) Teach the student how to tell the different soldering coppers apart and what they are used for.

(8) After finishing lessons on solders, acids, cutting acid, and the acids required on different metals, return to the subject of soldering coppers and observe if students know the right copper to use for the first soldering lesson.

(9) Give careful attention to the proper forging and tinning of the soldering copper and make the student well acquainted with all acids and dipping solutions, lecturing on the safety precautions to be exercised before using them.

(10) Demonstrate the proper position to stand at bench and for holding the work as well as the soldering copper and observe individuals carefully to see that instructions are understood and carried out.

(11) Give as much individual instruction as possible, but never do work for an individual.

(12) See to it that each student gets practice in doing those operations which are hardest for him. This is to counteract the tendency of students doing those operations which they have already mastered just because they are easy.

SUGGESTIONS FOR TEACHING LESSON I—FORGING AND SOLDERING COPPER

(1) Call attention to the fact that coppers must be kept in shape by forging, and that a soldering copper can be forged on an anvil as readily as iron or soft steel.

(2) Teach the student how to heat the copper for forging and the proper temperature of heat to attain.

(3) Lay emphasis on dividing the blows and not do all the hammering necessary on one side at one time.

(4) Explain that a round copper must be squared at the end before drawing out.

(5) Show the student what adjustments are necessary for having the gas furnace produce a blue, hot flame.

(6) Teach the student the correct method for removing dross, or oxide and scale and impress upon him that this is important before forging.

SUGGESTIONS FOR TEACHING LESSON II—TINNING POINTED COPPERS

- (1) Demonstrate to the student how valueless a soldering copper is unless it is well tinned.
- (2) Emphasize clearly that soldering cannot be done with untinned or poorly tinned tools and do the job well.
- (3) Explain how utterly impossible it is to make solder adhere to a copper or any other surface that is covered with dirt or oxide.
- (4) Make the student acquainted with the important principles to be remembered in tinning the soldering copper. First, the cleansing of the copper, making it bright and free from all metallic oxides; the second step to keep the copper in that condition until the third operation can be completed, which is covering the bright surface with a film of lead and tin alloy.
- (5) Demonstrate the brick method of tinning coppers with rosin even if the instructor should prefer sal ammoniac.

SUGGESTIONS FOR TEACHING LESSON III—PREPARING A FLUX OF CHLORIDE OF ZINC

- (1) Teach the student the necessity of selecting a flux for each operation which can protect the metal to be soldered and the solder to be used and which also can withstand and readily transmit to the degree of heat necessary for soldering.
- (2) Let the student know that chloride of zinc is perhaps the best known of soldering fluids.
- (3) Lay great emphasis on the precautions necessary in preparing a flux of chloride of zinc.
- (4) Impress upon the student that he must always avoid acid fumes.
- (5) Explain why a clean glass jar should be used in preference to an iron dish.
- (6) Never allow the student to use anything else but a zinc rod or wooden stick for stirring.
- (7) Before allowing the acid to be poured make sure there is no further sign of any action between the zinc and the acid.
- (8) If the preparing of a flux of chloride of zinc is to be practiced, personal and careful supervision by the instructor is of vital importance.

SUGGESTIONS FOR TEACHING LESSON IV—SOLDERING FLAT SEAMS AND FLAT-LOCK SEAMS; AND
LESSON V—SOLDERING VERTICAL SEAMS

- (1) In lesson IV the student is to receive his first practical soldering lesson.
- (2) See that the proper tools are on the bench.
- (3) Have the equipment arranged conveniently.
- (4) See that all acids to be used have their proper position on the bench which will prevent the student from breathing acid fumes.
- (5) Give an oral examination on the five important principles to be remembered by anyone who attempts to solder.
- (6) Impress upon the student that solder is expensive.
- (7) Provide a receptacle to receive all solder drops.
- (8) Before the student commences to solder he must understand well the lessons on forging and tinning the soldering copper, which lessons should be thoroughly practiced.
- (9) Have the student understand the heating furnace in use, and if gas is used, emphasize that the blue flame is the best and that a soldering copper can not be heated to good advantage in the yellow part of the flame.
- (10) Make sure that the student at any time never has too much soldering fluid in his cup.
- (11) It is important that the student understands well the common fluxes that are used in soldering practice and what such fluxes are used on and the special precautions to be exercised in using the same.
- (12) Have the student prepare his own dipping solution.
- (13) If practical teach the student how to make his own swabs.

(14) Before attempting to solder, the student should know how to take solder and how to handle the soldering copper.

(15) The student should be made acquainted with the construction of seams as used in sheet metal work.

(16) From No. 28 gauge galvanized iron make up some simple project with butt, lap, lock, and vertical seams and lecture on the same.

(17) If equipment is available, teach the student how to make these different sheet metal projects to be soldered.

(18) Strongly emphasize the point that cleanliness is the motto to be remembered for good soldering.

SUGGESTIONS FOR TEACHING LESSON VI—SOLDERING REPAIR WORK, AND LESSON VII—STRIPPING ORNAMENTS AND PATTERNS

(1) A practical lesson can be given on soldering repair work on an old, leaky wash boiler or any other vessel.

(2) Teach the student the use of the proper soldering copper depending upon the repairs to be made.

(3) Scraping and cleaning repair work is important.

(4) Make the student acquainted with the best fluxes to be used on repair work.

Lesson VII

(1) Teach the student how to make his own pattern.

(2) If circular shears is available show the student how to cut a circle by machine.

(3) The strip may be cut with hand shears, but if squaring shears is available teach the student how to cut up sheet metal with the squaring shears.

(4) Give instructions on the use of the divider.

(5) Give a lesson on circumference, how to use the circumference table and the use of the circumference rule.

(6) If a forming machine is not available for forming the strip, provide some simple means for forming the same.

(7) Have the student cut the pattern and strip with extreme accuracy for assuring a good soldering job.

7. REFERENCE BOOKS FOR INSTRUCTORS

(1) Sheet Metal Workers' Manual. Broemel. The Peck, Stow & Wilcox Co., Southington, Conn. \$2 per copy. Special discount in quantities.

(2) Essentials of Sheet Metal Work and Pattern Drafting. Daugherty. The Peck, Stow & Wilcox Co., Southington, Conn. \$1.50 per copy. Special discount in quantities.

NOTE.—This work is incorporated in the Sheet Metal Workers' Manual by Broemel and is Chapter V of the Sheet Metal Workers' Manual.

(3) Sheet Metal Work, an Industrial Vocation for School Shops, giving suggested floor plans and construction of sheet metal shop bench. The Peck, Stow & Wilcox Co., Southington, Conn.

(4) Pocket Manual No. 16A. Advertising literature. Sheet Metal Working Machines and Tools. The Peck, Stow & Wilcox Co., Southington, Conn.

(5) Pexto Shop Ways. Advertising literature. A Wall Card of Useful Tables. The Peck, Stow & Wilcox Co., Southington, Conn.

(6) Soldering and Brazing. Hobart. Advertising literature. The Sheet Metal Publication Co., 154 Nassau Street, New York City.

(7) Kinks—Vol. 1. The Sheet Metal Publication Co., 154 Nassau Street, New York City. \$1 per copy.

(8) Sheet Metal—A trade journal devoted to the interests of the sheet-metal worker. Publisher, E. A. Scott, 156 Fifth Avenue, New York City. Published monthly. \$1 per year. The December, 1918, issue contains the following articles: "Turning bankers into good sheet-metal mechanics"; "Practical shop management, methods and equipment"; "Repairing auto radiators."

8. EQUIPMENT AND MATERIALS

The following list of soldering equipment is recommended for a general shop. The tools in this list should, therefore, be provided by the hospital or school shop.

A. Individual equipment for group of five students

- | | |
|------------------------------------------------------------|--------------------------------------------------------|
| 5 double burner, brick-lined, gas furnaces. | 5 swabs (omit if these are to be made by the student). |
| 5 pairs 1½-lb. pointed soldering coppers, handled. | 5 earthen jars for dipping solutions. |
| 5 pairs 3-lb. pointed soldering coppers, handled. | 5 soft building bricks. |
| 5 round-face ball pein hammers, 2 lbs. | 5 hand shears or snips, No. 8 straight. |
| 5 files, flat bastard, 10-inch. | 5 hand shears or snips, No. 9 circular. |
| 5 scrapers, triangle. | 5 square-face setting hammers No.3. |
| 5 ring scratch awls. | 5 bars solder half and half. |
| 5 loose leg dividers, 8-inch. | 5 blocks sal ammoniac (sufficient to tin coppers). |
| 5 cold chisels, ¾-inch. | 5 pounds rosin. |
| 5 marble slabs, 14" square by 3" thick. | 5 mallets, 3-inch face. |
| 5 acid cups (omit if these are to be made by the student). | 5 forging iron or steel plates. |

B. General Equipment

- | | |
|------------------------------------------------------|--------------------------------------------------------------------------------|
| 2 soldering benches, 10 ft. by 43 in. | 2 sheets of galvanized iron 36x96 inches No. 28 guage. |
| 1 small anvil. | 12 sheets of IC tin. |
| 1 vise. | 2 pairs 3-lb. hatchet coppers. |
| 1 blacksmith hand hammer, 2 lbs, 10 oz. | 5 pairs 3-lb. bottom coppers. |
| 4 one-quart glass Mason jars. | 1 flat-nose plier, 8-inch—1 side-cutting plier, 8-inch. |
| Sal ammoniac, block | } Purchase in quantities most convenient and economical and to best advantage. |
| Sal ammoniac, powdered form. | |
| Muriatic acid. | |
| Rosin. | |
| 1 sheet of zinc (to be purchased at best advantage). | 1 monkey wrench, 10-inch. |
| | 1 pipe wrench, 10-inch. |
| | 1 gasoline blow torch. |
| | 1 circumference rule. |

Solder half and half. Buy to best advantage, having a few bars on hand after students have been each provided with one bar.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

THE TRADE OF THE SHEET-METAL WORKER

The sheet-metal working industry is a large and growing industry intimately connected with the building trades. An increasing proportion of the costs of building are spent for cornice work, roofing, skylight, ventilating, heating, etc. It is also represented in modern automobile construction, furniture, and boat building, and in the construction of a great many manufactured products.

The working of metal in sheet form is light, interesting, and instructive. As a trade the wages paid are better than in some other related trades and there is always a demand for competent men. To-day more than ever the sheet-metal working trades offer unusual opportunities to men who possess the necessary training.

The extensive use of sheet-iron and sheet-metal products and the importance of sheet-metal work is discussed in *Sheet Metal Workers' Manual*, by Broemel, pages 11 to 21, inclusive.

Soldering

Skill in the use of the soldering iron is a prime requisite for successful sheet-metal working. There are no secrets about the use of solder which may not be learned by the beginner, but the skill of the good mechanic comes only with practice. Thinking while you are reading or working will greatly shorten the learning of the process.

From the very beginning all sheet-metal projects are planned with great care and much time and labor are consumed before they are brought to that stage of completion when ready for soldering. The soldering operation can further the workmanship and attractiveness of the job or make for an absolute loss in materials, time, and labor.

The good sheet-metal worker prides himself in his adeptness and skill in the use of the soldering copper; therefore, soldering is an essential for successful sheet-metal working practice.

GENERAL INSTRUCTIONS TO STUDENTS

Soldering

Means the joining, uniting, or welding together of pieces of metal with fusible alloys of tin and lead.

Solder

Soft solder, as generally used, is an alloy of tin and lead and is put up in convenient sticks. It melts at about 370 degrees and unites easily with the tin, lead, zinc, copper, and brass, but not easily with iron or steel. It is commercially called "Half and Half," meaning half tin and half lead.

Fluxes

When soldering two pieces of metal together a perfect bond can not be made unless oxide is kept out of the joint. A flux must be used to prevent oxidation while the soldering operation is going on.

Common fluxes

1. A flux is a material in any form, powder, paste or liquid, which helps to make the solder unite more easily with the metal.
2. A good flux for one kind of metal may not work well on others.
3. *Rosin* is used as a flux for soldering tin plate, bright copper, or lead in either powdered or dissolved form. Dissolved in gasoline, it makes a good flux.
4. *Chloride of zinc—killed acid*—is made by cutting zinc with muriatic acid and is used generally for soldering clean galvanized iron, zinc, copper, and brass. It is employed extensively on repair work.
5. *Raw muriatic acid*, also called hydrochloric acid, is used in its raw state diluted with water on zinc and also for galvanized iron. The sheet-metal worker prefers muriatic acid in its raw state to any other soldering fluid for galvanized iron.
6. *Borax*, in powdered or dissolved form, is used for brass.

Soldering tools

(References given below are to pages of Sheet Metal Workers' Manual)

Heating furnaces

1. Soldering requires heat. You may use gas, coal, or charcoal or a gasoline torch. Very few shops except in remote country places use the coal or charcoal pot.
2. For general shop work the gas furnace is more extensively employed (p. 142, fig. 129). Soldering coppers are used for applying the heat.
 1. *The straight copper* forged to a pointed shape is best adapted for soldering the seams in tinware or any other bench work (p. 142, fig. 130).
 2. *The bottom copper* wedged shape is used for soldering sheet-metal bottoms on the inside (p. 142, fig. 132).
 3. *The hatchet copper* swivels on its handle for giving it a proper angle in soldering special work and is employed for long, heavy seams (p. 142, fig. 133).

4. *The roofing copper* is used for soldering the flat seams on roofing (p. 142, fig. 131).

Soldering scraper is used on repair work for scraping clean the surface of the metal preparatory to soldering (p. 143, fig. 136).

Soldering copper handles. Manufacturers offer the roofing copper with handles and shields fitted. Handles for coppers of other shapes come separate (p. 143, fig. 134).

Lesson I.—Problem—Forging the soldering copper

Text: (Sheet Metal Workers' Manual, p. 179)

The soldering copper is of little value unless it is well forged to the shape desired for the work in hand.

Forging:

1. Anneal or soften the copper in the heating furnace and heat to proper color.
2. If you use gas, take care not to let the copper get smoked up in the yellow part of the flame. A blue flame is hotter.
3. After heating remove the dross or oxide and scale.
4. Forge to the required shape.
5. Allow the copper to cool out after forging.

Questions:

1. What are the three common types of soldering coppers in use?
2. What form of copper is universally used?
3. When the copper is received from the dealer or manufacturer, can you put it to immediate use?
4. What would you do to a new copper?
5. Is the copper hammered cold?
6. Why is the copper heated before hammering?
7. Is the copper forged directly after heating?
8. What must be removed from the copper before forging?
9. What method is used for removing the dross and scale?
10. What is the technical term of dross?
11. What would happen if you hammered a copper cold?
12. To what color should a copper be heated for forging?
13. What would you forge the copper on?
14. What is the best kind of hammer to use?
15. How are the blows on the copper distributed in hammering?

Lesson II.—Problem—Tinning points of coppers

Text: (Sheet Metal Workers' Manual, p. 179)

The soldering copper is valueless unless tinned. Only a poor job will result with untinned or poorly tinned coppers.

A. Cleaning of the copper:

1. Solder will not adhere to the copper bit covered with dirt or oxide.
2. Heat the copper to make free from metallic oxides.
3. A copper can not be tinned unless first made absolutely clean and free from oxide which is a technical name for dross or scale.
4. Make the copper clean, as directed (p. 179).

B. Tinning the copper with sal ammoniac:

1. Heat to proper temperature.
2. Clean surface of the copper's point with sal ammoniac.
3. Take stick of solder in left hand. Grasp the copper in right hand.
4. Melt proper proportion of solder on sal ammoniac.
5. Tin the copper's point.

C. Tinning the copper with rosin:

1. Select a very soft building brick.
2. Scrape out a channel in the brick with a cold chisel $\frac{1}{8}$ to $\frac{1}{4}$ inch deep.
3. Leave the gritty substance of the scrapings remain in the channel. The copper in rubbing against this substance makes for better tinning.
4. Make copper clean.

C. Tinning the copper with rosin—Continued.

5. Heat the copper.
6. Melt a piece of rosin about the size of a hen's egg in the channel of the brick.
7. Add a chunk of solder.
8. Rub the hot copper on all sides in the bath of solder and rosin until the copper is properly tinned.

Tinning the copper with rosin is a tinning method used when soldering tin and rosin is being used as a flux.

Questions:

1. Does the forging of the copper place it in immediate condition for use?
2. What would you do to a copper after forging?
3. What is the result of an untinned or poorly tinned copper?
4. What operation frees the copper from dirt or oxide?
5. On how many sides and how high from the point should the pointed copper be filed for tinning?
6. What temperature of heat must be attained for tinning the copper?
7. How would you go about tinning a copper with sal ammoniac?
8. How would you tin a copper with rosin?
9. What important principle is to be borne in mind for keeping the copper in good working condition?
10. When is rosin used generally for tinning a copper?

Lesson III.—Problem—Preparing a flux of chloride of zinc

A. Acid container:

1. Use a clean glass, such as is used for canning fruit. A 1 or 2 quart Mason jar is satisfactory.
2. Bear in mind that an iron dish should never be used.
3. Place the jar in a dish as a safety precaution in the event that the jar should crack during the process of mixing the solution.

B. Pouring acid:

1. Avoid fumes.
2. Never put water in the jar first and pour in the acid afterward. Very strong acid coming in contact with water is liable to cause accident.
3. First pour a portion of muriatic acid in a dry clean jar.
4. Add one-eighth to one-quarter as much clean water.

C. Stirring:

1. Never use a piece of iron or steel for stirring.
2. Stir the solution with a piece of zinc or a wooden stick.

D. Cutting the acid:

1. Cut up small, clean pieces of zinc with hand shears.
2. Don't put dirty zinc in the acid.
3. If the zinc is dirty, clean by dipping in another dish of acid, washing well.
4. Drop the zinc into the solution piece by piece to avoid sudden boiling and to prevent overflowing (p. 176).
5. Stir the contents of the jar occasionally, always with a wooden stick or piece of zinc.
6. Allow the zinc to remain in the solution until no further sign of any action between the zinc and acid is evident.
7. If no gas bubbles can be made to appear by shaking, stirring, or adding more water, the solution is no longer muriatic acid, but what is left in the jar is known as chloride of zinc.

E. Filtration:

1. Use a funnel, tucking several thicknesses of cloth, filter paper, or a piece of clean cotton waste in the funnel's bottom.
2. Place the funnel in another clean jar, pouring the solution from the mixing jar.
3. The zinc chloride is now ready to be stored until needed.
4. Keep out dirt. Cover the jar well.

F. Using zinc chloride as a flux:

1. When required for use, pour a small quantity in the acid cup provided.
2. Dilute with one or two parts of water.
3. A too strong flux will do harm to the work and to the soldering tools.
4. Whatever flux is used should be diluted with water to the weakest condition for the work in hand.

Questions:

1. What is chloride of zinc?
2. What materials will it solder well?
3. Would you use an iron dish as a satisfactory container for mixing acid solutions? Why?
4. What is the best kind of jar to use?
5. What are the important safety precautions to exercise in mixing and using acid solutions?
6. Is water or acid poured in the jar first?
7. What will happen if water is poured in the jar before the acid?
8. What is used for stirring the solution? Why?
9. What is placed in the muriatic acid to kill or cut it?
10. In cutting the muriatic acid would you drop large pieces of zinc in the acid?
11. What will happen if the zinc is not dropped into the solution in small pieces?
12. If a flux is made too strong what action does it have on the working tools?
13. On what materials is rosin used as a flux?
14. When is muriatic acid in its raw state better?
15. On what materials is borax used for soldering?
16. On what materials can chloride of zinc be used?

GENERAL INSTRUCTION ON SOLDERING PRACTICE

Study illustration.—Sheet Metal Workers' Manual, p. 184

A. Making ready for soldering:

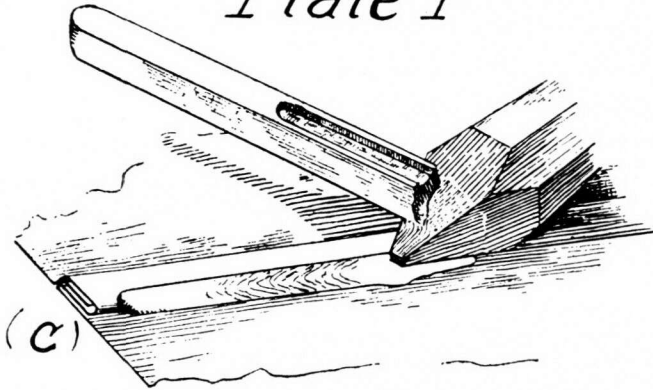
1. The soldering bench is constructed of wood of any convenient length and width.
2. Have only necessary tools at your bench.
3. Use order in keeping all tools, materials and acids on the bench.
4. Get together equipment (p. 183).
5. Arrange equipment on the soldering bench as illustrated (p. 184, fig. 160).
6. The marble slab should always be clean.
7. Keep the bench free from dirt and solder drippings.
8. Avoid acid fumes.
9. Keep acid and dipping solutions back of marble slab and away from under your nose.
10. Be sure you know the solution in your acid cup and what it is used for. Have cup fitted $\frac{3}{8}$ inch deep or less.
11. Make a memorandum of the different fluxes used in soldering, their composition and on what materials they are intended for.
12. Don't begin to solder until your soldering copper is properly forged and tinned.
13. Have clearly in mind just what you aim to accomplish by each effort.
14. Work slowly and carefully, and try to attain accuracy. Accuracy at a slow rate of work is preferable to the reverse.
15. There are five important principles to be remembered by one who attempts to solder.
 - (1) The soldering copper must be kept clean and well tinned.
 - (2) A good soldering flux must be used and one which is suited to the metal. Keep the flux clean.
 - (3) The metals to be soldered must be clean.
 - (4) The joint to be soldered must be heated above the melting point of the solder.
 - (5) Cleanliness is the motto.
16. Do not try to work fast, as the heat must flow ahead of the solder, and this takes time.
17. Save the solder drops. Solder is valuable.

B. Dipping solution:

1. When using charcoal, gasoline or gas for heating, the point of the copper becomes discolored.
2. Use an earthen fruit jar and mix a solution composed of powdered sal ammoniac as directed (p. 180).
3. Bear in mind that the point of the heated copper when taken from the furnace must be dipped quickly into this solution to facilitate soldering and for making the tinned surface bright and clean.
4. Try not to confuse your dipping solution with soldering fluid.

C. Taking solder and using the copper:

Study Plates I and II

Plate I*The Application of Solder to a Long Seam. A method not practical on small work*

D. Swab for brushing seams:

1. Good swabs can be purchased, but if they must be made by the student, use bright tin and cow-tail. Never use copper.

*Lesson IV.—Problem—Soldering flat seams and flat-lock seams**(Text: Sheet Metal Workers' Manual)*

Study Figure 158, page 181: Method of soldering a flat seam.

Study Figure 148, page 165: Construction of lap seam.

Study Figure 159, page 182: Soldering flat-lock seams.

Study Figure 149, page 165: Construction of flat-lock seam called folded seam.

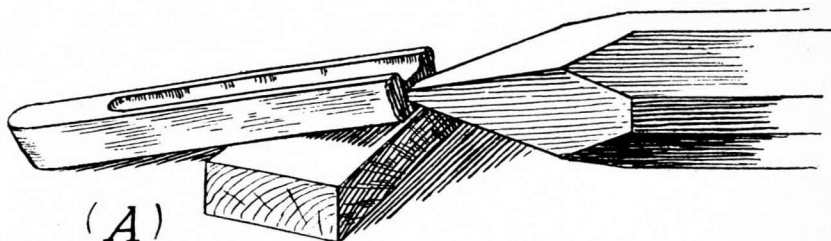
A. Soldering flat seams:

1. Prepare material for soldering (p. 180).
2. Have the surfaces fit well, see that they are clean.
3. Work is often discolored by the hot copper burning the bench underneath and leaving a dark spot on the surface of the metal. Avoid this by placing the work to be soldered upon the marble slab.
4. Use flux as directed (p. 180).
5. Heat the copper.
6. Try if the copper is hot enough, touch to lump of copper or hold it near your face to test the heat.
7. Try to use precaution for not overheating the copper or the tin will be burned off.
8. Brush seam with soldering fluid, allowing acid to penetrate as directed (p. 180).
9. Touch the hot copper to the end of a bar of solder.
10. Tack the seam with solder (pp. 180, 181, fig. 158 at X).
11. Be careful to soak the seam as directed (p. 181).

B. Soldering flat-lock seams:

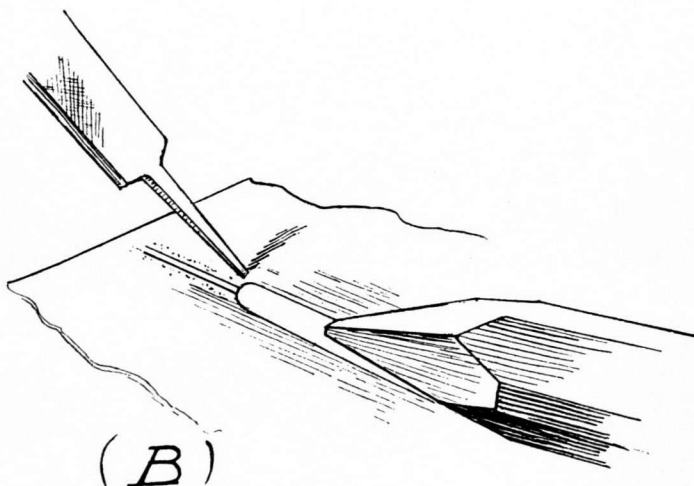
1. Solder in the same manner as directed in soldering flat seams.
2. Be sure to place the copper directly upon the seam as shown (fig. 159 at A, p. 182).
3. Particular attention should be paid to the improper way of placing the copper as shown (fig. 159 at C, p. 182).

Plate II



(A)

Taking Solder



(B)

Running a Plain Seam Solder is taken as at "A"

C. Soldering a grooved seam on the inside of sheet-metal articles:

1. See construction of grooved seam (p. 167, fig. 150).
2. Study the wrong way of placing the copper on the seam (fig. 159 at E, p. 152).
3. Be sure to hold the copper directly upon the seam, heating it thoroughly and drawing the solder into the joint as directed (p. 181-182).

Questions:

1. What are the spots marked X (fig. 158, p. 181) called?
2. What precaution is to be used in soldering from one tack to another?
3. How is the solder applied to the seam (fig. 158, p. 181)?
4. What is the position of the soldering copper when soldering flat-lock seams?
5. How is the copper applied to grooved seams on the inside of sheet-metal articles?
6. If the soldering copper requires retinning, how is it done?
7. What test is used for deciding if the copper is hot enough?
8. With what fluid are the seams brushed before applying solder?
9. How would you brush a seam and what would you use to brush it with?
10. What necessary equipment should be on the bench?
11. What is the marble slab used for?
12. What position are acids and dipping solutions supposed to have on the bench?
13. What is the difference between a dipping solution and a soldering fluid?
14. What is the dipping solution used for?
15. What is the soldering fluid used for?
16. What is another name for soldering fluid?
17. Name five important principles to be remembered by one who attempts to solder.
18. How would you mix a dipping solution?
19. What would you do with a soldering copper directly after heating and before soldering?
20. What operation is used in soldering practice for keeping the tinned surface of the soldering copper bright and clean?
21. What is a swab?
22. If you had to make your own swab how would you make it?
23. What is the definition of soldering?
24. What is soft solder?
25. How many common fluxes can you name?

Lesson V.—Problem—Soldering vertical seams

(Text: Sheet Metal Workers' Manual. Study Figure 157, page 178—Lap vertical seam)

1. Soldering vertical seam (p. 182).
2. Forge the soldering copper as directed (p. 182).
3. Compare the soldering copper as used for vertical seams with the copper used for other seams.
4. Study Figure 157 at B, page 178.
5. Tin the copper shown in Figure 157 at B, page 178, and as directed on page 182.
6. Solder by holding the handle higher than the copper for reasons as given (pp. 182–183).
7. Movement of the copper and drawing the solder into the seam, Figure 158 at D, page 181.

Questions:

1. What kind of seam is shown in Figure 157–A, page 178?
2. What kind of soldering copper is used for soldering vertical seams?
3. What are the forging dimensions of the bottom copper?
4. What is the shape of the bottom copper?
5. How would you tin a bottom copper?
6. What method is used for controlling solder on vertical seams?
7. Why is the bottom copper tinned differently than the pointed copper?
8. When soldering vertical seams how is the handle held in relation to the copper?
9. What is the movement of the copper on the seam?
10. In what work is the vertical seam more often used?

Lesson VI.—Problem—Soldering repair work

1. For old work and repairing, sheet-metal articles must have surfaces free from dirt or any substance which will prevent the solder adhering to the metal (p. 183).
2. Be sure to make parts to be soldered perfectly bright by scraping.

3. Bear in mind that good soldering can not be done before the surface is clean and is made free from dirt or other substances.

4. The scraping operation is facilitated with scraper shown in Figure 135, page 143. The scraper, Figure 136, page 143, may also be used.

5. When soldering old work use chloride of zinc or killed acid as a flux.

6. When soldering old tinware chloride of zinc should be used as a flux instead of rosin.

Questions:

1. Will solder adhere to an unclean surface?
2. How are the surfaces of old work prepared for soldering?
3. What is a good flux for old work?
4. Can rosin be used as a flux on tinware?
5. When is it better not to use rosin on tinware?
6. What is the best flux for old tinware?
7. Can the surface of old work be scraped clean with any other tool besides the scraper?
8. What is the best tool to use for scraping?

Lesson VII.—Problem—Stripping ornaments and patterns

(Text: Sheet Metal Workers' Manual, page 185. Study Pattern A, Figure 138, page 152)

1. Transfer Pattern A to the metal as directed (pp. 151–153).
2. Use dividers (p. 139, fig. 120).
3. Cut the circle with the hand circular snips (p. 132, fig. 104).
4. Do all straight cutting with the straight snip (p. 132, fig. 103).
5. Cut a strip three-fourths of an inch in width and equal in length to the circumference (p. 185).
6. Find the circumference of the circle (pp. 484–529).
7. Form the strip into a circle (p. 185).
8. If the material is light, the circle can be formed by the hands or with an improvised means such as the instructor may provide. Use a forming machine if one is available.
9. Place the pattern on the marble slab.
10. Place the circular strip in proper position (p. 185).
11. Be sure the circular strip is placed directly on top of the pattern flush with the outer edge.
12. Solder on the inside.
13. Do not wrap the strip around the outer edge of the pattern.
14. Hold in position as page 185.
15. Tack as you would when soldering a flat seam.
16. Solder the seam between tacks.
17. Use a flux as directed (p. 185).

Questions:

1. What tool is used for scribing a circle?
2. What mistake does the student often make in using the divider?
3. How would you transfer Pattern A, Figure 138, Page 152, to the metal?
4. How is the circumference of a circle found?
5. What is the position of the strip on the pattern before soldering?
6. In soldering work of this kind how is it held?
7. Why must the seam be tacked before soldering?
8. What tool is used for cutting the circle?
9. What tool is used for cutting the strip?
10. Why is the work soldered on the marble slab instead of directly on the bench?

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Unit Course—Sheet-Metal Work 2—Essentials of Sheet-Metal work

SHEET-METAL WORK

February, 1919—Trial edition

PART ONE. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the student who has selected sheet-metal working as a vocation of interest to him as a trade and is intended to fit him for the sheet-metal shop or in the shops of manufacturing industries where sheet metals are extensively employed. No previous experience in sheet-metal working is required, but a common-school education is desirable.

2. THE AIMS OF THE COURSE ARE—

- (1) To give a balanced practice in all of the operations involved in common sheet-metal work.
- (2) To acquire skill in the use of the more common machines and tools used in sheet-metal work.
- (3) To develop judgment by actual use in the selection, use, and care of sheet-metal working tools and machines.
- (4) To become familiar with the various kinds of metal used in sheet-metal working, proper construction of a sheet-metal joint, and the cutting, shaping, and forming of articles made of sheet metal.

3. THE LENGTH OF THE COURSE

This course is intended to cover about 30 hours of instruction, study, and practical work by the student. In order to bring the course within this time the instructor will make necessary modifications or substitutions in the problems for construction by the student.

4. OUTLINE OF LESSONS

The following problems selected as essentials for successful sheet-metal working are suggested for this course. These problems are all worked out in Sheet Metal Workers' Manual, to which book the pages given refer. The instructor is at liberty, however, to modify the problems or substitute others according to conditions prevailing with the class and student.

1. Transferring patterns and templates.
2. Cutting patterns and templates.
3. Method of construction of body for one-quart pail.
4. Construction of bottom for one-quart pail.
5. Setting down and double seaming of one-quart pail.
6. Constructing cover of one-quart pail.
7. Forming wire bails for pails.
8. Riveting ears on pails.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating are available it is recommended that final rating be recorded as follows:

The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- (1) Execution of work:
 - (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
 - (b) *Technique*.—Does the student use workmanlike methods?
Does he exercise reasonable economy in use of materials?
Is he neat and orderly in care of tools?
- (2) Finished Product:
 - (a) *Accuracy*.—Should be determined by the record of errors that may occur for improper seam allowances, waste in cutting, appearance of seams and edges, etc.
 - (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
 - (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?
- (3) Interest:
 - (a) *Attitude toward work*.—Does the student love his work or does he watch the clock?
Is he likely to continue in this line of work?
 - (b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work?
Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?
- (4) *Test problem*.—A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

GENERAL SUGGESTIONS TO THE INSTRUCTOR FOR CONDUCTING THE WORK

1. Give the class a few simple lessons in pattern drafting, making them accustomed to tools necessary for making and transferring patterns.
2. It is important that the student be taught extreme accuracy in making patterns and templates.
3. Emphasize the importance for proper seam allowances and teach the student short methods used for figuring seam allowances.
4. Make a memorandum of questions where the answers are given in the lesson sheets.
5. Have the student answer questions that the lesson sheets give for oral examination before beginning work on each problem.
6. Lecture on various kinds of sheet metal and make clear what they are, touching on their important points of manufacture.
7. Teach the student how to make a simple tray for holding rivets.
8. Where a machine is to be used on any problem make the student familiar with the construction, adjustment, and operation before using the machine.
9. The student should learn how to tell the different stakes and hand tools apart and what they are used for.

10. Demonstrate the proper position to stand at the bench and how to hold the work as well as the tools.
11. It is important that the student knows the correct method for using the hand snip
12. Demonstrate the proper use of the bench shears, the straight snip and the circular snip.
13. Give as much individual instruction as possible, but never do work for an individual.
14. See to it that each student gets practice in doing those operations which are hardest for him. This is to counteract the tendency of students doing those operations which they have already mastered just because they are easy.
15. More time perhaps will have to be given to the correct operation of the burring machine for burring than any other machine used.

EQUIPMENT AND MATERIALS

The following list of sheet-metal working equipment is recommended for a general shop. The tools in this list should, therefore, be provided by the hospital or school shop.

1. Individual equipment for group of five students

- | | |
|---------------------------------------------------------|-------------------------------------------|
| 5 ten-inch cutting nippers. | 2 vises. |
| 5 flat-nose pliers, 8-inch. | 5 bench shears, elbow, length of cut 4''. |
| 5 single-leg extension dividers, 8-inch. | 5 blocks of lead. |
| 5 mallets, 3-inch face. | 5 hollow mandrel stakes, length 40''. |
| 5 ring scratch awls. | 5 solid mandrel stakes, length 30''. |
| 5 circumference rules. | 5 blowhorn stakes. |
| 5 sets of solid punches. | 5 steel squares. |
| 5 hollow punches, $\frac{3}{4}$ -inch. | 5 creasing stakes. |
| 5 riveting hammers, No. 2. | 5 needlecase stakes. |
| 5 raising hammers, No. 3. | 5 hand shears or snips, No. 8 straight. |
| 5 conductor stakes. | 5 hand shears or snips, No. 9 circular. |
| 5 double-seaming stakes. | 5 square-face setting hammers, No. 3. |
| 5 square stakes, $2\frac{3}{4} \times 4\frac{1}{2}$ ''. | 5 each rivet sets, 00, 1, 3, 5, and 8. |
| 4 bench plates, 30 x 8''. | 5 hand groovers, No. 5. |

2. General equipment

- | | |
|----------------------------------------|----------------------------------------------------------|
| 1 holdall revolving machine standard. | 1 slip roll forming machine 30 x 2''. |
| 1 small turning machine without stand. | 1 Moore's patent double-seaming machine, 10-inch throat. |
| 1 small burring machine without stand. | 1 squaring shears, 30-inch, capacity No. 18 gauge iron. |
| 1 setting-down machine without stand. | 1 cornice brake, 42-inch. |
| 1 wiring machine without stand. | 2 tables, 4 x 12 ft. |
| 1 beading machine without stand. | 1 monkey wrench, 10-inch. |
| 1 circular shears. | 1 side-cutting plier, 8-inch. |
| 1 portable bench punch. | |
| 1 30-inch bar folder. | |
| 1 30-inch rapid grooving machine. | |

3. Materials

- | | |
|--------------------------------------------------|-------------------------------------------------------|
| 12 boxes of assorted rivets. | 1 box IC tin 20 x 28. |
| No. 12 gauge wire. Buy to best advantage. | 25 lbs. small tin kettle ears. Buy to best advantage. |
| 3 sheets, 26 x 96, No. 28 gauge galvanized iron. | |

Reference books for instructors

1. Sheet Metal Workers' Manual. Broemel. The Peck, Stow & Wilcox Co., Southington, Conn. \$2 per copy. Special discount in quantities.
 2. Essentials of Sheet Metal Work and Pattern Drafting. Daugherty. The Peck, Stow & Wilcox Co., Southington, Conn. \$1.50 per copy. Special discount in quantities.
- NOTE.—This work is incorporated in the Sheet Metal Workers' Manual by Broemel and is Chapter V of the Sheet Metal Workers' Manual.

3. Sheet Metal Work, an industrial vocation for school shops—giving suggested floor plans and construction of sheet metal shop bench. The Peck, Stow & Wilcox Co., Southington, Conn.

4. Pocket Manual No. 16-A. Advertising literature. Sheet Metal Working Machines and Tools. The Peck, Stow & Wilcox Co., Southington, Conn.

5. Pexto Shop Ways. Advertising literature. A Wall Card of Useful Tables. The Peck, Stow & Wilcox Co., Southington, Conn.

6. Turning Bankers into Good Sheet Metal Mechanics. Advertising literature. Practical Shop Management. Methods, and Equipment. In December, 1918, issue of *Sheet Metal*, a trade journal devoted to the interests of the sheet-metal worker. Publisher, E. A. Scott, 156 Fifth Avenue, New York City. Published monthly, \$1.00 per year.

DIRECTIONS FOR TEACHING

Lesson I.—Constructing the body of a 1-quart pail

1. The instructor will give a demonstration of preparing the different sheet-metal joints as are used in sheet-metal working practice, showing the student how these joints look when finished.

2. Give an oral examination on sheet-metal joints after the demonstration.

3. Explain in detail and how to make drawing for the body of a 1-quart pail.

4. Explain the transfer of simple patterns directly to the metal and the method of transferring a paper pattern to the metal.

5. Teach the student how to place his template to avoid unnecessary waste of material.

6. Emphasize on the care to be exercised for making the proper seam allowance.

7. Show the student how to cut patterns and templates.

8. Explain the different gauges as are used on the squaring shears and how to adjust the same.

9. Make the student thoroughly acquainted for the proper cutting of notches.

10. Teach the student how to properly adjust the bar-folding machine for folding the side seam and wire edge, and how to set the gauge.

11. Observe that the student holds the work properly and adjusts the roll correctly when wiring the top edge of body.

12. Demonstrate the proper adjustment of the gripping and the rear forming rolls of the forming machine.

13. Caution the student never to form a wired edge in any other position between the rolls than the grooves cut in the end of the rolls for this purpose.

14. Teach the student how to adjust the grooving rolls in the grooving machine for securing the proper pressure upon the seam.

15. Show the student how to adjust the gauge on the beading machine and the correct position for holding the work.

16. Give as much time as possible for learning the knack of operating the burring machine.

Lesson II.—Constructing the bottom of a 1-quart pail

1. Explain to the student how to find the size of bottom.

2. Teach the student how to make allowance for edges.

3. Show the student how to use the circular shears for cutting circles of different diameters and how to set the gauges for cutting many of the same size of circles.

4. Give the student the proper method for squaring the blanks previous to circle cutting, avoiding as little waste of material as possible.

5. Give as much time as possible to burring the edge of the bottom.

6. Give the student a demonstration of how this is done, showing him the proper position of the hand for holding the work and how to burr without buckling.

Lesson III.—Setting down and double seaming a 1-quart pail

1. Teach the student the machine and hand operation of setting down.
2. Give the student a demonstration on holding the work and operating the setting-down machine for closing the seam properly preparatory to double seaming.
3. When double seaming by hand, show the student how to avoid disfiguring the metal, as will result if the sharp end of the hammer is struck against the body of the article.
4. Give as much time as possible to the proper adjustment of the setting-down machine for producing a well-finished seam.
5. If time is allowed, give the student practice in making a tin cup with a flanged bottom, soldering the bottom to the body of the cup, showing the difference between the method of attaching the bottom to the tin cup and double seaming the pail.
6. Give an exercise in double seaming by hand, using the double-seaming stake and mallet.

Lesson IV.—Constructing cover and finishing 1-quart pail

1. If practicable, have the student make his own raising block.
2. Lecture on the use of the raising hammer.
3. Teach the student how to make template for hoop with care.
4. Observe if he understands laying out the pattern of the 1-quart pail cover.
5. Give special attention to the exercise in raising pail cover.
6. Show the student the proper use of the turning machine.
7. If time is allowed, give an exercise on a flaring pan for showing the use of the turning machine in wiring the tops of flaring articles.
8. Without any instruction, have the student prepare the ring for the cover and fasten the ring.
9. Give a lecture on the steel square and point out its good uses as related to sheet-metal work.
10. Before riveting the ears to the pail, give an exercise on riveting.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately, or the instructor can readily duplicate them on typewriter or mimeograph. With some students there may be no objection to using the complete bulletin at one time.

SHEET-METAL WORKING AS AN INDUSTRIAL VOCATION

Sheet-metal working as a trade has many attractive features. It is a large and growing industry represented both in the building trade and in modern automobile construction, furniture and boat building, and in the construction of manufactured articles. The introduction of autogenous welding and electric welding has done much to make possible the use of sheet metal in new forms. The working of metal in sheet form is light, interesting, and instructive.

As a trade the wages paid are better than in some other related trades.

The extensive use of sheet-iron and sheet-metal products and the importance of sheet-metal work (Sheet Metal Workers' Manual, by Vroemel, pp. 11 to 21, inclusive).

All well-trained, expert sheet-metal workers can draft their own patterns, and those who have been unable to see any use for intersections and development in mechanical drawing can quickly see the relation between this branch of drawing and the drafting of patterns through the study of this course.

Pattern drafting is not the object of this course, but it will teach the construction of sheet-metal projects with the tools and machines as are used in daily shop practice after the pattern is secured.

Power presses and dies have so revolutionized the tinware manufacturing industry that tinware is no longer manufactured with hand tools and machines as are referred to in this course, but many tinware projects such as the tin cup, dipper, water pail, etc., require many

operations in their construction, the principles of which are the same as enter into such work as is done in the sheet-metal shop and by the manufacturer of sheet-metal products.

Therefore, in order to afford the student study and practice for understanding the underlying principles of sheet-metal working, a simple tinware project is used as a problem for study.

GENERAL INSTRUCTION TO STUDENTS

(Reference text: Sheet Metal Workers' Manual)

Machines and tools used in sheet-metal work

1. *The squaring shears* (p. 22).—Sheets of metal as ordered from the mill and tin plate must be sheared or cut and trimmed for the article manufactured. The machine used for this work is called the squaring shears.

2. *The circular shears* (p. 39).—Where circular blanks cut from sheet metal are used, such as bottoms of vessels, cans, tanks, sheet-metal barrels, etc., the machine used for cutting circles is called the circular shears.

3. *The forming machine* (pp. 74-75).—The forming machine, often called rolls, is used for bending sheet metal or wire to a curved form. Stovepipe and the bodies of vessels are formed into cylinders from the flat sheet with the forming machine.

4. *The folding machine* (p. 45).—The bar folding machine is universally used for turning a hem or lock on the edge of a piece of sheet metal. It will also prepare the edge of a sheet of metal to receive a wire. Lock seams in pipe and the bodies of vessels are prepared with the folding machine. Other types of folding machines as are commonly used in sheet-metal working practice are shown in pages 48-49.

5. *The brake* (p. 59).—This machine, commonly called the cornice brake, has a wider range of usefulness than the folding machine. The brake has attachments for forming moulded shapes and to almost any pattern, as shown in page 62.

6. *The grooving machine* (p. 79).—After a lock seam has been folded on the folding machine it is grooved and flattened down, called grooving, and for which work the grooving machine is used. The hand groovers, page 136, Figure 116, are also used for grooving, principally on heavy work, but where it is possible to use the machine it is better to do so.

7. *The turning machine* (p. 83).—The turning machine is used to prepare a seat in the edge of a can body or similar work for receiving a wire. The turning machine is very much used in wiring the top edge of tapering vessels.

8. *The wiring machine* (p. 85).—The seat for the wire prepared with the turning machine and the wire placed under the edge prepared for it, the wiring machine tucks in the edge of the metal around the wire. In wiring cylindrical work the wire is formed into a ring between the grooves cut in the rolls of the forming machine. The wire ring is slipped in the seat as prepared by the turning machine and the metal is tucked around the wire.

9. *The burring machine* (p. 87).—This machine is used for turning an edge called burring on cylinders of metal or on discs such as can bottoms.

10. *The setting-down machine* (p. 88).—This is used to close the seams left by the burring machine preparatory to double seaming.

11. *The double-seaming machine* (p. 107).—The Moore's patent double-seaming machine is more simple in its operation over other types of double-seaming machines. The edges on the body and bottom of a sheet metal vessel properly prepared with the burring machine and when the flange as left is closed down with the setting-down machine, this flange is turned up against the body of the vessel with the double-seaming machine.

12. *The beading machine* (pp. 95-96).—Sheet-metal articles are made ornamental, but, most important, they are greatly strengthened with the beading machine. Using crimping rolls with the beading machine, a crimp and bead is made in pipe, as shown in page 99, Figure 62.

13. *Bench tools* (pp. 127 to 140, inclusive).—Stakes, bench plates, scratch awl, snips, riveting, setting and raising hammers, mallets, prick, solid and hollow punches, rivet sets, hand groovers, circumference rule, wire gauge, dividers, flat-nose pliers, and the cutting nippers are bench tools used in the sheet-metal shop and have an important part in sheet-metal working practice.

SHEET-METAL JOINTS

1. *Single edge or closed lock* (p. 163).—Single edges formed on sheet metal are used in constructing seams and hemming the edges of sheet metal.
2. *Double-hemmed edge* (p. 164).—The double-hemmed edge or double lock is most commonly utilized to strengthen sheet-metal forms.
3. *Wire edge* (p. 164).—The wire edge or open lock is used where sheet-metal articles are increased in strength by enclosing a wire in certain of their edges.
4. *Lap seam* (p. 165).—Ordinary lap seams are used in the construction of small cylinders, square pipe, etc. This seam is usually soldered or riveted.
5. *Folded seam or hook lock* (p. 165).—A single edge is turned on the metal and the edges are hooked together. After hooking they are hammered down with the mallet. Seams of this kind are used on flat seam roofing and other work.
6. *Grooved seam* (p. 167).—With light material the grooved seam is the universally used method of joining the edges of sheet metal.
7. *Allowance for grooved seams* (pp. 166–167).—Allowances for grooved seams must always be taken into consideration, and accurate allowances of material for all seams that the work calls for is important.

RIVETING

Sheet metal may be fastened together firmly by riveting, and many times where strength is necessary both rivets and solder are used. The size of the rivets used depends both on the thickness of the metal and on the strength required in the joint.

The tinner usually sets his rivets by what is called "blind riveting." He places the rivet under the sheets of metal and draws it through by driving a rivet "set" over it with a hammer. This process requires some practice, but makes a very firm joint because the rivet always fits the hole and may be drawn up very tightly. On some light work the rivet sometimes spreads out and stretches the metal around it. For this reason and because it is easier to place them accurately, rivets may be set in holes already punched in the sheets of metal. This is always done in heavy work. This process is recommended for beginners and the holes should be carefully located and punched with a solid punch over a block of wood on end grain.

In heading a rivet a light hammer is used and light blows which form a head on the rivet slowly are necessary for good work. Use the rivet set to form a smooth head on the rivet.

Tinners' rivets, which are usually coated with tin, are sold by the box and are numbered 8 ounces or 10 or 12 or 14 ounces, which means that 1,000 rivets of one size weigh a certain number of ounces. Larger rivets from 1 pound up to 16 pounds are sold, which are rated in pounds or per thousand.

CUTTING PATTERNS AND TEMPLATES

1. The bottom of the one-quart pail can be cut with the hand snip or by machine. The machine as used for circle cutting is called the circular shears.
2. Before a circle can be cut with the circular shears the blank from which the circle is to be cut must be squared to proper size with the least possible waste of material.
3. All squaring of sheet metal is done on the squaring shears.
4. Study cutting of circles by hand, pages 156 to 162, inclusive.
5. Learn the proper cutting of circles with circular shears, page 39, Figure 12.
6. Learn how to set the squaring shears for squaring sheet metal with the squaring shears, page 23, Figure 1.
7. See how corners for seams and edges are notched with the snip, page 160, Figure 143.
8. The machine method for cutting notches is given on page 117, Figure 77.
9. Practice cutting with the bench shears.
10. Practice cutting with the straight hand snip.
11. Practice cutting with the circular hand snip.

LESSON ONE—PROBLEM—CONSTRUCTING THE BODY OF A 1-QUART PAIL

(Reference text: Sheet Metal Workers' Manual. Study drawing, fig. 176, p. 209)

A. Method of construction of body

1. In Figure 176, page 209, are shown the elevation patterns and dimensions of a 1-quart covered pail.
2. Simple patterns are transferred directly to the metal.
3. Sheet metal patterns that are not so simple are drawn on paper and transferred to the metal as instructed, pages 151 to 155, inclusive.
4. Scribe outline of pattern, Figure 176, page 208, on a sheet of IC tin.
5. The template secured, lay it on the material to be used and circumscribe with the scratch awl.
6. Shift the template in such a way to avoid unnecessary waste of material.
7. Cutting pattern and templates. Study pages 156 to 162, inclusive.
8. After the template has served its purpose, punch a $\frac{3}{4}$ -inch hole in one end and hang up for future use.

B. Squaring the body, pattern "A"

1. Use the squaring shears, Figure 1, page 23.
2. Cut edges true and straight.
3. Study plan and end elevation of the squaring shears, Figure 144, page 161.
4. Set the long bed gauge or front gauge, measuring with the ordinary rule from the edge of the lower cutting knife to the face of the gauge.
5. Cut the pattern "A."

C. Notching patterns

1. Having cut the material the required size, the next step is to notch the pattern for wiring as shown by the upper shaded corners.
2. The upper corners are notched for wiring, as is more plainly shown by a, b, c, and d, pattern "C," Figure 171, page 200.
3. The width of the notches are equal to one and one-half times the width of the $\frac{1}{8}$ -inch edge turned for the seam.
4. When a $\frac{1}{8}$ -inch edge is turned, $\frac{3}{8}$ inch is allowed for the seam and one-half of this amount, or $\frac{1}{4}$ inch, is the depth of notch.
5. This will allow the notched corners to fit snugly together.
6. The grooved seam is to extend up to the wire as shown at o—pattern "C," Figure 171, page 200.
7. Distance a and b should be slightly greater than the allowance for covering the wire as given, pattern "C," Figure 171, page 200.
8. A continuous cut is made from a to b to c, cutting b and c on an angle of 45 degrees—pattern "C," Figure 171, page 200.
9. The lower corners are notched on an angle of about 45 degrees, the width being one and one-half times the width of the edge to be turned—pattern "C," Figure 171, page 200.
10. The corners g and h will then fit together, leaving only one thickness of metal on the lower edge after the grooved seam is completed—pattern "C," Figure 171, page 200.
11. Cut notches with the hand snip.
12. When cutting out the shaded portion of patterns the end of the shear blade should never extend beyond the point as shown at m, Figure 143, page 160.

D. Folding the wire edge

1. Use the bar folding machine, Figure 15, page 45.
2. The wire edge must be rounded as shown in Figure 147, page 164.
3. Use No. 12 gauge wire.
4. Study table of wire allowance, page 193.
5. Lower the wing in the folder equal in width to the diameter of the wire to be used, making the adjustments in the folder as directed, page 47.

6. Set the gauge on the folder equal in width to one and one-half times the diameter of the wire to be used.

7. Insert the edge of the pattern between the gripping jaw and the folding blade in the folder, pressing the edge against the gauge; pull over the bar and fold the wire edge.

E. Folding the side seams

1. Readjust the wing in the folder for a closed lock.

2. Set the gauge on the folding machine to the width of the edge required and turn a single edge as shown at "A," Figure 150, page 167.

F. Wiring top edge of body

1. Use wiring machine, Figure 45, page 85.

2. Select a straight piece of No. 12 wire equal in length to pattern "A," Figure 176, page 208.

3. Lay the wire under the edge as made with the folding machine.

4. Close the metal over the wire for about 1 inch from the end with a hammer over the horn on the standard of the wiring machine.

5. Study Figure 167, page 194—Sectional view of wiring machine.

6. Position for wiring of pattern "A," Figure 176, page 208, is the same as "D," Figure 167, page 194.

7. Tuck the metal around the wire as illustrated and directed, page 194.

G. Forming the body

1. Use the forming machine, Figures 35 or 36, pages 74-75.

2. The next step in the construction of the body pattern "A," Figure 176, page 208, is to form the body on the forming machine or rolls.

3. The wired edge is placed in one of the grooves cut in the end of the rolls for this purpose. The wire should never be formed elsewhere than in these grooves.

4. Before inserting the work in the forming machine place the work on the conductor stake, Figure 100-4, Page 131.

5. Slightly curve both ends of the wire by striking it lightly with a mallet. This enables the work to pass easily over the back roll of the forming machine.

6. Form the body in the forming machine the same as a cylinder.

H. Grooving the side seam

1. After the body is formed, hook the edges together as shown at "B," Figure 150, page 167.

2. Seam is then laid on the horn of the grooving machine, Figure 40, page 79.

3. Note appearance of seam before grooving, Figure 41, page 80.

4. Run the rolls in the grooving machine over the seam, grooving the seam as shown in Figure 41, page 80.

I. Beading or swaging the body

1. Stiffening and ornamenting bodies of vessels is an operation made with the beading machine, Figure 58 or 59, pages 95-96.

2. For beading the pail use triple bead rolls.

3. For position of the work and hands and for operating the beading machine see Figure 155, page 174.

4. Operate the beading machine as directed page 174.

J. Burring bottom edge of body

1. The diameter of the body is shown at "C" and the allowance for a $\frac{1}{8}$ -inch edge on the body is shown at "B," Figure 176, page 208.

2. Use small burring machine, Figure 47, page 87.

3. Operation for burring the edge on the body is shown in Figure 177, page 209.

4. Set the gauge and burr the edge on body as directed, pages 209-210.

Questions

1. What machine is used for squaring?
2. How would you set the long bed gauge or front gauge?
3. How must the edge of a pattern be prepared before it can be wired?
4. What is the definition of wiring?
5. When is the wire edge or open lock used?
6. What part of the cutting blade of the hand snip is used for cutting notches?
7. What is the name of the machine used for folding a wired edge?
8. What is the shape of a wire edge?
9. How would you adjust the bar folding machine for turning a wire edge?
10. How would you adjust the bar folding machine for folding the side seam?
11. What machine is used for finishing the operation of wiring?
12. How is the wire laid in the edge prepared by the folding machine?
13. What machine would you use for forming the body?
14. What part of the rolls in the forming machine are used for the wire edge?
15. How would you prepare a wired body previous to forming?
16. What machine is used for grooving the side seams?
17. What effect has the beading machine when used on the body of a vessel?
18. What is the edge as prepared on bottoms called?
19. What machine is used for preparing edges on bottoms?
20. Where is the single edge or closed lock used?
21. When is the lap seam used?
22. What kind of seam is universally used for joining the edges of sheet metal?
23. What allowances must be taken into consideration when laying out patterns?

LESSON TWO—PROBLEM—CONSTRUCTING THE BOTTOM OF A 1-QUART PAIL

A. Cutting the bottom

1. The pattern for the bottom and allowance for edges are shown at "E," Figure 176, page 208.
2. To find the size of bottom measure the diameter of body and to this dimension add four times the width of the burr, allowing for a seam $\frac{1}{8}$ inch, to be turned by means of the small burring machine.
3. To cut the bottom use a circular shears, Figure 12, page 39.
4. Square the blank with the squaring shears.
5. After the square blank is secured place the blank between the clamping disks in circular shears.
6. Set the tail piece of the circular shears as directed page 39.
7. Fix the blank in central position as directed page 40.
8. Clamp the blank.
9. Cut the circle.

B. Burring the edge of bottom

1. Use burring machine, Figure 47, page 87.
2. Turning edges on the burring machine is a difficult operation for the beginner.
3. It requires careful work and practice to become efficient in burring an even edge on a circular piece of a flat plate without burring the edge or warping the metal.
4. After the bottom is cut, then proceed to burr the edge.
5. Having made an allowance for a $\frac{1}{4}$ -inch seam on the bottom, set the gauge on the burring machine a scant $\frac{1}{8}$ inch from the edge of the upper roll.
6. This will allow for the take-up of the material after the edge is turned.
7. Hold the bottom in a horizontal position, place the edge of the metal on lower roll touching the gauge.
8. Follow further instructions for operating the burring machine as given on page 202.
9. Study Figure 172, page 202.

Questions

1. What machine is used for cutting bottoms?
2. How would you set the tailpiece to cut the bottom for a 1-quart pail?
3. What would you do before cutting the circle?
4. What machine is used for preparing the blank for circle cutting?
5. What position is the blank to have between the clamping disks?
6. What machine is used for burring the edge of bottom?
7. How much allowance is made for seam on the bottom?
8. How would you set the guage of the burring machine for a $\frac{1}{4}$ -inch seam allowance?

LESSON THREE—PROBLEM—SETTING DOWN AND DOUBLE SEAMING A 1-QUART PAIL

(Reference text: Sheet Metal Workers' Manual)

A. Setting down or peening

1. After having burred the bottom snap the bottom on to the body as shown at "A," Figure 50, page 89.
2. The next operation is to close seams at "A," Figure 50, page 89, as shown at "B," Figure 51, page 89.
3. Use the setting-down machine, Figure 49, page 88, or Figure 52, page 90.
4. The work is held bottom upward and the edge run between the two rolls, compressing the edges, making a tight, smooth joint ready for double seaming.
5. Position for holding the work and operating the setting down machine is shown in Figure 179, page 212.

B. Setting down or peening by hand

1. Figure 178, page 211, shows how the setting down operation can be effected with the hammer, the flat top of the work placed on the square stake.
2. Care must be taken not to strike the sharp edge of the hammer against the body of the article. This will make a disfigured mark on the metal, showing careless work.
3. This method of setting down edges is universally used when seaming heavy work or large articles made from light metal.
4. The position of the hands on the work when using this method of setting down seams is shown in Figure 178, page 211.

C. Double seaming

1. After the setting-down machine has done its work, the flange left by it is turned up against the body of the vessel to make both the seam and bottom tight. (See fig. 67, p. 105, at "A" and "C.")
2. For double seaming the pail use double-seaming machine, Figure 69, page 107.
3. Operate the double-seaming machine as directed, pages 107-108.

D. Double seaming by hand

1. The pail can be double seamed by hand over the double-seaming stake and with the use of the mallet.
2. Position of the hands on the work for hand double seaming is shown in Figure 180, page 212.
3. Follow instructions as given, pages 212-213.

Questions

1. What is another name for setting down?
2. What operation is necessary in preparing work for double seaming?
3. What machine is used for setting down seams?
4. How is the work held when setting down seams?
5. When using the hand method of setting down, what tools are used?
6. What care must be exercised in setting down by hand?
7. What is the machine for double seaming called?
8. What tools are used for double seaming by hand?

LESSON FOUR—PROBLEM—CONSTRUCTING COVER AND FINISHING 1-QUART PAIL

(Reference text: Sheet Metal Workers' Manual. Study Figs. 181-182, pp. 214-215)

A. Template for hoop

1. The method of laying out the patterns and the construction of the 1-quart pail cover is shown in Figure 181, page 214.
2. Construct hoop for pail cover as directed pages 213-214.

B. Raising block

1. Prepare the raising block to raise or bump the work into form from the flat metal by means of the raising hammer, Figure 110, page 134, and raising block, Figure 182, page 215, and as directed, page 216.

C. Raising pail cover

1. Prepare the raising block as directed, page 216.
2. Cut pail cover "E," Figure 181, page 214, with the circular shears.
3. The blank must be squared with the squaring shears before cutting the circle.
4. The pail cover "E," Figure 181, p. 214, prepared, it is ready for the raising process.
5. Proceed in raising pail cover as directed, page 217.

D. Flanging the cover

1. After the cover has been hammered or raised into shape turn a wide edge or flange on the rim to allow for joining the hoop and cover by means of a single seam as shown at "A," Figure 181, page 214.
2. Use the turning machine, Figure 43, page 83.
3. The first step in flanging is to set the guage on the turning machine about $\frac{3}{8}$ inch from the edge of the upper roll.
4. Place the edge of the cover against the guage, bring down the upper roll and revolve the work in the machine, making a depression or bead as shown at No. 1, Figure 183, page 218.
5. Finish the cover as directed, page 218.
6. The ring for the cover is made from a piece of metal $1\frac{1}{2}$ inches long and $\frac{1}{2}$ inch in width, as shown at "G," Figure 181, page 214.
7. Construct and fasten ring as directed, pages 218-219.

E. Forming wire bails

1. Small malleable ears that are riveted to the pail and the progressive steps used in forming the bail are shown in Figure 184, page 219.
2. Construct the bail as directed, pages 219-220.

F. Placing the ears

1. Find position for ears with a steel square as shown in Figure 186, page 220.
2. Rivet the ears to the pail, attach bail, finish pail, soldering the side seam from the inside.

 Rehabilitation monograph—Joint Series No. 47

Unit Course—Painting and Decorating 2—Kalsomining and Whitewashing

PAINTING AND DECORATING

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This unit course is intended for the man with a common-school education who expects to follow the occupation of painting and decorating and who wishes to become something more than a mere "brush head." The work outlined in this course does not necessarily require previous experience in this line of work.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

Upon completing this unit course the student should be able to do the following:

- (1) Appreciate the purpose of kalsomine as a decorative agent.
- (2) Mix and apply properly to newly plastered walls the various kinds of distemper or water-color paint in common use, and prepare and refinish old kalsomined surfaces.
- (3) Secure employment as an "approver" in a painting shop or with a contractor doing high-class work or in any of the larger hotels, apartment houses, or real estate concerns which regularly employ a force of painters and decorators.
- (4) Take additional unit courses which are provided in this subject, thereby increasing his skill and proficiency.

3. LENGTH OF THE COURSE

The time required to complete the work of this unit is estimated at about 30 hours, distributed as follows:

Kalsomining, new work—		Hours
1. Rigging scaffolding with planks and saddles and covering floors.....	1	1
2. Sandpaper and filling cracks and dentations.....	2	2
3. Mixing shellac and shellacking cracks.....	1	1
4. Mixing and varnishing sizing, ceiling and walls.....	2	2
5. Soaking blue and whiting.....	1	1
6. Tinting whiting, adding glue, and straining.....	2	2
7. Applying kalsomine.....	3	3
8. Washing of brushes and taking proper care of same.....	1	1
9. Cleaning trim, folding drop cloths, and cleaning nails.....	2	2
Kalsomining, old work—		
10. Washing off old kalsomine.....	1	1
11. Cutting out cracks.....	2	2
12. Filling cracks.....	2	2
13. Shellacking cracks.....	1	1
14. Sizing ceilings.....	1	1
15. Mixing and kalsomining—same as in new.....	0	0
Whitewashing, new work—		
16. Brushing off dust and filling cracks.....	2	2
17. Mixing whitewash.....	2	2
18. Applying whitewash.....	1	1
19. Care of brushes.....	1	1
20. The treatment of old work (consists of removing all loose particles).....	2	2
Total.....		30

4. EQUIPMENT AND MATERIALS

The personal equipment to be provided by the student and the general equipment to be supplied by the school will be the same for this course as for Unit Course No. 1 on painting new work.

The materials required for kalsomining and whitewashing which the school should supply are as follows:

For kalsomining—

Plaster.
Glue.
Whiting.
Prepared kalsomine.
Alcohol.
Shellac.
Alum.
Ceiling varnish.
Benzine.
Dry colors or colors ground in water
for tinting.

For whitewashing—

Lime.
Soap.
Salt.
Linseed oil.
Alum.
Dry tinting colors.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating be recorded as follows: The average student will be rated good, the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in the commercial shop should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- Ability to sandpaper and prepare ceiling and walls of all descriptions.
- Ability to apply kalsomine with an even film or coating.
- Ability to determine when sizing is dry enough to apply the kalsomine.
- Ability to handle brushes.
- Ability to cut out cracks and plaster same.
- Ability to touch up cracks with shellac.
- Ability to size ceiling and walls.
- Personal care of hands and clothing.
- Care of pots and pails.
- Care of materials.
- Care taken in measuring ingredients.
- Care of brushes.
- Care and use of drop cloths.
- Care of sponges.
- Care of glue.
- Care of old kalsomine.
- Care of lime.

The instructor should also determine the value of each student according to interest and ability shown.

6. OUTLINE OF LESSONS

The course consists of four problems representing the four commonly used finishes of new walls and ceilings, as follows:

- Problem I. Kalsomining new walls and ceiling.
- Problem II. Whitewashing new walls and ceiling.
- Problem III. Preparing and rekalsomining old ceiling.
- Problem IV. Preparing and retinting ceiling and covered with wall paper.

7. GENERAL SUGGESTIONS TO THE INSTRUCTOR

The trade of house painter is too often supposed to consist of manual processes only. It is thought by many that a young man has only to follow others in order to become a competent workman. However, a great change has taken place in this occupation, and it is now admitted that every effort should be made to give technical instructions, to teach the principles on which the practice is based, to interest the minds of students in the higher branches of the trade, and to show that the more the mind comprehends the requirements, the better the hand will execute the work. The course presented herewith is intended to make the student something more than a mere "brush hand."

There probably is no trade that presents so many variable conditions for the consideration of the workingman as that of painting. No one rule can be given that will apply to every job. Treatment that will answer in one instance may be unsuited to another case. On some jobs conditions may be such that the treatment must be modified.

Experience and a knowledge of materials must then determine the proper course to pursue.

The best method of teaching this subject is to provide a room with walls newly plastered upon which students may work. A newly finished house, if available, is an ideal laboratory or workshop for the students' practice of this course. In order to master the principles involved in the problems presented, and within the time allotted, each student should cover a minimum of 400 square feet of wall surface, one-fifth of which should be on the ceiling.

The instructor should explain to students how to study and interpret the student's instruction sheets; he should carefully demonstrate each step, then let the student follow with kalsomine and brush. While the students are working, the instructor should be alert to see that the work is being properly done. Devote special attention to the laying on and careful brushing of the kalsomine.

A study of the directions in the student's instruction sheet will suggest to the instructor many points concerning the method of conducting the work.

Students should be taught to interpret the architect's specification for finishing the various rooms of a building, to estimate the cost of doing the work according to these specifications, and to write orders for the necessary materials.

Each problem should be thoroughly mastered by the student before starting another. In the progress of the work, students may be classified according to the proficiency shown, and each group advanced as rapidly as it deserves.

In this subject neatness is of primary importance. The teacher should therefore impress upon the student the following points:

1. He should at all times keep all pots, pails, floor, and trim clean and systematically arranged.
2. He should be particular about the care of brushes, tools, putty knife, etc.
3. He should not boil glue in a room that may be used for a paint shop or where fumes of turpentine or benzine may ignite.

DIRECTIONS FOR TEACHING PROBLEM I—KALSOMINING NEW WALLS AND CEILINGS

1. Instruct the student as to the importance of rigging scaffolding in such a manner that he will have a clear way over the entire surface to be kalsomined.
2. There should be no obstructions that would cause painter to stop his work to move same after once started.
3. Show student how to test the glue as a binder—also danger if kalsomine has too much glue or not enough.
4. Explain to student what happens when glue is soaked and not used. (It will rot.)
5. Explain the importance of not mixing enough. Student should be careful about mixing enough to be used in one day.
6. Explain how to test sizing and why it should not be too strong, as kalsomine will slide. This pertains to shellac also.
7. Be sure to instruct students to remove all kalsomine from trim just as soon as kalsomining is done. It is more difficult to wash off when too dry and may chip varnish on trim if left on too long.

8. Instruct importance of mixing tinting colors before adding to kalsomine.
9. Explain that it is absolutely necessary to strain all kalsomine through a wire or cheesecloth strainer before using.

DIRECTIONS FOR TEACHING PROBLEM II—WHITEWASHING NEW WALLS AND CEILINGS

1. Be sure walls are thoroughly washed before whitewashing.
2. Explain the danger in mixing; whitewash will burn unless enough water is added.
3. Explain that binders should always be added when mixing.
4. Be sure to have students wash brushes at once when finished, as the hair may be destroyed if left in too long.
5. Show the danger of lime burning trim if left on to dry, as lime will burn wood if hot.

DIRECTIONS FOR TEACHING PROBLEM III—PREPARING AND REKALSOMINING OLD CEILING

1. Show students care of protecting walls. Be sure that drop cloths are clean and clear of dust before tacking up.
2. In washing off, be sure the students do not splash water all over room. They should not dip brush too deep into water. In washing, be sure sponge is not too wet.
3. Be sure to instruct to thoroughly wash off old kalsomine. If not thoroughly washed off, the new kalsomine is apt to chip off.
4. In cutting out cracks, students are to be shown how to find lips on ceiling and describe just about how much to cut out.
5. In shellacking cracks and sizing old ceilings, be sure shellac and size are not too strong.

DIRECTIONS FOR TEACHING PROBLEM IV—PREPARING AND RETINTING BADLY STAINED CEILING

1. Instruct students to be careful not to dig holes when scraping off paper.
2. Paste should be thoroughly washed off before sizing for kalsomine.
3. Plastering, shellacking, sizing, and kalsomining, same as previously mentioned.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS

Description of kalsomine

Kalsomining is sometimes called painting in distemper or tinting with water paint.

The name is often called and spelled "calcimine."

Kalsomine consists of whiting (sometimes called Paris white, Spanish white, or chalk), and it comes in lump or powdered form and tinted any color that may be desired.

Use of glue in kalsomine

Glue is used as a binder. The proportion generally used is 1 pound of white shell glue to 26 pounds of whiting. If the kalsomine is to be decorated, more glue should be added; where walls are kalsomined and tinted a darker shade, sometimes as much as $1\frac{1}{2}$ pounds is added to prevent it from rubbing off.

If not enough glue is added, it will rub off; if too much glue is added, it will chip off.

PROBLEM I. KALSOMINING NEW WALLS AND CEILING

I. Specification

"Room No. 5.—Ceiling and walls:

"To be prepared and kalsomined, with tinted kalsomine to match sample of color submitted.

"The above-mentioned work to be done in a first-class workmanlike manner; all materials to be the best of their respective kinds."

II. Directions for work

1. Prepare the ceiling and walls. Various methods:

(a) The most modern and commonly used—give the entire plaster surface a thin coat of ceiling varnish mixed very thin with benzine, sometimes as thin as 70 per cent benzine and 30 per cent ceiling varnish.

(b) The shellac treatment: When wall or ceiling has a suction, shellac is used very thin and thinned down with alcohol (about 2 pounds white shellac gum to 1 gallon alcohol). This comes prepared and only needs thinning.

(c) A very old method still very often used where stains show: Give the entire plaster surface one coat of paint with 80 per cent turpentine, 20 per cent oil to about 15 pounds white lead to the gallon.

(d) The sizing method, termed "Dutch sizing:" Made by mixing soap, alum, and glue. Some call this alum size. Very seldom used.

For the work of this problem use the first method described above.

2. Mix the kalsomine. This is done by soaking the whiting in cold water until it becomes a heavy paste. Into this paste mix first the color, then the glue for binder. The color should be soaked in water before adding to the whiting. The color is darker when wet and can be correctly judged only when dry. After the color is thoroughly mixed in add glue which has been soaked in water, boiled and cooled. (It should not be used when hot.) Now strain the mixture and thin it with water to the proper consistency.

3. Apply the kalsomine. Kalsomine should be carefully applied with a large brush. It sets quickly and should therefore be worked rapidly. The edges should always remain wet and care should be taken that no laps show. When once started the entire section should be completed without stopping. On a large ceiling or wall at least two men should work together.

4. Make out bill for the job. Use the form given in the preceding course—Painting and decorating 1.

PROBLEM II. WHITEWASHING NEW WALLS AND CEILING

I. Specification

"Room No. 6.—Ceiling and walls:

"To be prepared and whitewashed two coats.

"The above-mentioned work to be done in a first-class workmanlike manner; all materials to be the best of their respective kinds."

II. Directions for work

1. Prepare ceiling and walls. This should be done by filling all cracks and dents with plaster or cement. The entire surface should be thoroughly broom brushed to remove all dust.

2. Make the whitewash.

(a) To 1 pail of unslacked lump lime add about 3 pails of cold or hot water and stir while it is boiling; add about 3 pounds of salt, $1\frac{1}{2}$ gallons of linseed oil, and about 1 pint of soft soap.

(b) The use of boiled powdered rice and glue as a binder is not recommended, as whitewash is used mostly in cellars, lofts, and stables, and this method is not as sanitary as the oil and salt binder. Blue and ocher added sometimes to give a tint.

(c) Whitewash is known as a pure white sanitary coating. Time has a purifying action in whitewash contact. It kills germs and does not act as a medium for their growth.

3. Apply the first coat of whitewash. This should be spread very thin.

4. Apply the second coat. Allow the first coat to dry. The second coat can be made heavy so as to cover all dark stains.

5. Make out bill for the job.

PROBLEM III. PREPARING AND REKALSOMINING AN OLD CEILING

I. *Specification*

"Parlor—Room No. 7.—Ceiling.

"To be washed off, cracks cut out, replastered with pure plaster of Paris, shellacked, entire surface varnished, sized and retinted a light cream color.

"Walls to be protected and brushed down after ceiling is retinted.

"Floors and woodwork are to be left in a clean condition.

"The above-mentioned work to be done in a first-class workmanlike manner.

"It is understood that all cracks are to be cut out to the lath where it is necessary, pure plaster to be used in filling in same.

"All materials are to be the best of their respective kinds; those used for tinting kalsomine are to be ground in water.

"All paints and materials are to be removed when work is completed."

II. *Directions for work*

1. Protect the walls. Tack clean drop cloths close to the ceiling over the entire wall. Care should also be given to the washing off and to the plastering and kalsomining, so as not to spatter.

2. Prepare the ceiling. Wash off entire ceiling with hot water, cut out all cracks as wide and deep as necessary in a V or dovetail shape; wet well with clean water; refinish cracks with two fillings. When crack is dry, sandpaper and shellac. When dry, size ceiling with a very thin coat of varnish size; allow to dry 24 hours.

3. Mix the kalsomine. This is done in the same manner as explained in Problem I.

4. Kalsomine the ceiling. This is done in the same manner as on new work. Be very careful not to allow a drop to fall from the brush.

5. Make out bill for the job.

PROBLEM IV. PREPARE AND RETINT CEILING WHICH IS NOW COVERED WITH WALL PAPER AND BADLY STAINED

I. *Specification*

"Dining-room—Room No. 8.—Ceiling.

"To be washed off, cracks cut out, replastered, entire surface (now badly stained) to be painted with one thin coat of flat white, and retinted a light cream to match sample selected by owner.

"Walls to have present paper removed, prepared, lined, and hung with burlap. Samples of color to be submitted to owner for selection."

NOTE.—The treatment of the walls specified above will be done in connection with the course on papering.

Other specifications as in the preceding problem.

II. *Directions for work*

1. Remove the wall-paper. This is done by thoroughly soaking over the old paper with a sponge until it will not absorb any more water. It should then be carefully scraped off with a broad putty knife. The wall should then be soaked with hot water and sponged off to remove any paste or glue that may remain.

2. Prepare the ceiling. Cracks are to be given one coat of shellac. Because stains are bad, the entire surface should be given one coat of shellac and one coat of thin flat paint. The paint should be dry before kalsomining the ceiling.

3. Mix and apply the kalsomine. This is done as in the preceding problem.

4. Make out bill for the job.

Rehabilitation monograph—Joint Series No. 48

UNIT COURSE—MACHINE SHOP PRACTICE 9—MATHEMATICS FOR THE UNIVERSAL MILLING MACHINE

MACHINE SHOP PRACTICE

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

It is assumed that the student has had some experience in a machine shop and has seen a milling machine in operation, or that the student while pursuing this course will have free access to a Universal milling machine, where he can put into practice, under the supervision of an instructor, the principles involved in this unit course. The student must be able to use common and decimal fractions and, in Lesson X, should be able to use trigonometric tables.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

A student completing this unit course should be able to quickly and accurately solve any problem pertaining to the Universal milling machine, and in addition he should be able to set up the machine correctly to do a great many typical milling-machine jobs.

3. LENGTH OF COURSE

The length of the course for a beginner would be about 20 to 24 hours, and for one who has had some experience on a milling machine or who has completed the unit course on mathematics for the engine lathe, about 16 to 20 hours.

4. EQUIPMENT AND MATERIALS

It is assumed that a Universal milling machine will be placed at the disposal of the student and that simple jobs involving the principles contained in this course will be supplied

5. MEASURING, RATING AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

For this course all problems can be checked as to whether they are right or wrong. There should be also some credit given for correctly setting up the machine. It is suggested that 75 per cent be allowed on study and 25 per cent on actual set up.

6. OUTLINE OF LESSONS

- (1) Use and operation of important parts of milling machine, together with the method of getting simple measurements.
- (2) Cutting speeds: Instruction as to how to change speeds and problems.
- (3) Cutting feeds: Practical study of how to change feeds and problems.
- (4) Simple indexing, practical study in operation of dividing head, problems, and practice.
- (5) Simple indexing, angular measure problems, and practice.

- (6) Differential indexing, practical study of set-up of dividing head, problems, and practice.
- (7) Compound indexing, exact practical study of operation of dividing head, problems, and practice.
- (8) Compound indexing, approximate study and problems.
- (9) Spiral milling shop method, practical study, problems, and practice.
- (10) Spiral milling, mathematical method, study, and problems.

7. SUGGESTIONS FOR CONDUCTING WORK

This unit course is made up of 10 lessons, and the student should have a good working knowledge of common and decimal fractions before taking up this course.

Lesson 1.—Use and operation of important parts

Unit lesson No. 1 is based on the principle that the student should, first of all, get acquainted with the important parts of the milling machine, together with the use and operation of same. In order to safeguard the machine from accident, it would be advisable to have a competent instructor assigned to assist the student while learning, by actual contact with the machine the principles involved in this lesson.

Lesson 2.—Cutting speed

The student should first be assigned to a competent shop instructor to be taught the method of changing the speed on the machine, and if there is a plate on the machine showing the change of speeds the student should be taught to use the table to make the various changes. He should return to classroom, where he will work out problems in this unit.

Lesson 3.—Cutting feeds

The student should first be assigned to a competent shop instructor to be taught the method of changing the feeds, and if there is a plate on the machine showing the change of feeds the student should be taught to use the table to make the necessary feed changes. He should then return to the classroom to work out the problems in this unit.

Lesson 4.—Simple indexing

The student should first be assigned to a competent shop instructor to be taught the use and operation of the dividing head. He should then return to the classroom to work out problems, and later return to the shop and given a simple job to do involving simple indexing.

Lesson 5.—Simple indexing angular measure

The student should work problems in classroom and later be sent to the shop to cut a simple heart-shaped cam for uniform motion.

Lesson 6.—Differential indexing

The student should be assigned to shop instructor to be taught the method of setting-up dividing head for differential indexing. He should then return to classroom to work out problems and later return to the shop and given a simple job involving differential indexing.

Lesson 7.—Compound indexing exact

The student should be assigned to shop instructor to be taught the method of operating dividing head for compound indexing. He should then return to the classroom to work out problems and later return to the shop and given a simple job involving compound indexing.

Lesson 8.—Compound indexing approximate

The student should work out the problems, but need not necessarily go to the shop to do the work, as the set-up of machine would be on the same principle as in lesson 7.

Lesson 9.—Spiral milling-shop method

The student should be assigned to shop instructor and taught the method of setting up the milling machine for cutting spirals. He should then return to the classroom to work out the problems and later return to the shop and given a simple job involving spiral milling.

Lesson 10.—Spiral milling mathematical method

The student must be able to use trigonometric tables and should work out the problems in the classroom, but need not necessarily go to the shop to do the work.

The student in this lesson should be furnished an old cutter to work out the fourth problem.

Test

A practical test can easily be arranged by giving the student a job requiring a working knowledge of one or more of these lessons.

8. LIST OF BOOKS OR REFERENCES

Colvin & Stanley: American Machinists' Hand Book. McGraw-Hill Company, New York, N. Y.

R. W. Burnham: Mathematics for Machinists. John Willy & Son, New York, N. Y.

Cincinnati Milling Machine Co.: Treatise on Milling. Cincinnati Milling Machine Co., Cincinnati, Ohio.

Brown & Sharpe: Treatise on Milling. Brown & Sharpe, Providence, R. I.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets, comprising Part 2 of this course, are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2

LESSON 1

Use and operation of important parts

You are about to take up your study of mathematics of the Universal miller, and as this course is based largely on the practical application of the various problems it is necessary that you fully acquaint yourself with the names and uses of the important parts of this machine.

1. Take this sheet and go where you will have access to a milling machine and study the picture carefully, locating first in the picture and then on machine the dividing head, tail center, cutter arbor, cross feed, vertical feed, longitudinal feed, back gears, spindle of machine, knee, and table saddle. Ask instructor to explain the use and action of these parts.

2. Notice the graduated dials on each, the longitudinal cross and vertical feeds. Does each dial have the same number of graduation marks? What measurement do these marks represent? How many divisions are there on the graduated dial of the longitudinal feed? What part of an inch would you move the table if you should give the longitudinal feed screw one complete revolution from zero to zero? Check this up by measuring with scale. See note.

How many divisions are there on the graduated dial of the cross feed? What part of an inch would you move the saddle if you should give cross-feed screw one complete revolution from zero to zero? Check this by measuring with scale. See note.

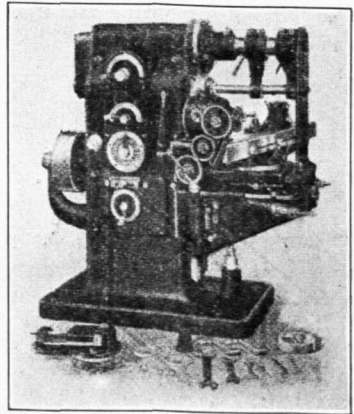


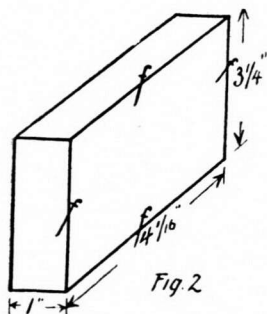
FIG. 1

How many divisions are there on the graduated dial of the vertical feed? What part of an inch would you move the knee if you should give the vertical feed screw one complete revolution from zero to zero? See note.

NOTE.—When getting a measurement on the miller by use of graduated dials, always make sure that the tension of the screw is in the direction the platen, saddle, or table is to be moved; also, when bringing the required graduation on the dial up to the pointer, that it is brought just up to the pointer. Should you happen to move graduation past the pointer, be sure that you turn back screw at least one-half turn and then bring up to required graduation; otherwise an error in measurement would result from the back lash in the screw.

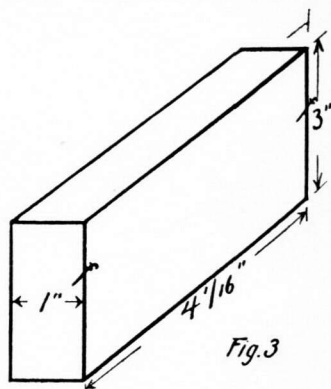
Problems

1. A piece of stock $4\frac{1}{8}$ inches long, $3\frac{1}{4}$ inches wide, 1 inch thick, held in a vise with stock extending the long way of table, is to be made 3 inches wide. What feed (cross, longitudinal, or vertical) would be used in doing this work? What feed screw would you adjust to get proper depth of cut? When the cutter just touches the work, place pointer at zero. What will the indicator register when the work is milled to the size required?



NOTE.—*F* indicates that surface is to be finished; therefore stock must be turned over.

2. You now have a piece of stock $4\frac{1}{8}$ inches long, 3 inches wide, 1 inch thick, to be held in the vise and milled to measure 4 by 3 by 1 inch. Place



indicator at zero when cutter just touches the stock. What will the indicator register when the stock is milled to size required?

LESSON 2

Cutting speed

The diameter of the cutter and the number of revolutions it makes per minute determines the cutting speed of the cutter, but care must be taken not to operate the cutter at too high speed, as by doing so would damage, if not ruin it. It is suggested that the following are safe speeds for material listed:

	Speed in feet per minute
Tool steel.....	20
Soft steel.....	48
Cast iron.....	50 to 60
Brass.....	90 to 120
Bronze.....	80

Rule

To find the cutting speed of a cutter, multiply the diameter in inches by 3.1416—the circumference in inches. Multiply the circumference in inches by the revolutions per minute, which equals surface speed in inches. Divide surface speed in inches by 12 (the number of inches per foot), which equals the cutting speed in feet per minute.

Example

A milling cutter 2 inches in diameter makes 80 r. m. (revolutions per minute). Find the cutting speed.

$$\frac{1.0472}{3} \times 40 \times 80 = 41.8880 \text{ feet per minute.}$$

To determine the r. p. m. (revolutions per minute) to cut any metal in list:

Multiply the speed in feet per minute by 12 (the number of inches per foot), which equals the speed in inches per minute. Multiply the diameter of the cutter in inches by 3.1416, which equals the circumference in inches. Divide the speed in inches by the circumference of the cutter in inches, which equals the revolutions per minute.

Example

A milling cutter 2 inches in diameter is to be used for milling cast iron. What should be the revolutions per minute?

$$\frac{50 \times 12}{2 \times 3.1416} = \frac{50}{.5236} = 95 + \text{r. p. m.}$$

$$\begin{array}{r} 95 + \\ .5236 \overline{) 50.0000} \\ \underline{47124} \\ 28760 \\ \underline{26160} \end{array}$$

Problems

1. A milling cutter 3 inches in diameter makes 60 revolutions per minute. Find the cutting speed. What metal would this speed be suitable to cut?
2. A milling cutter 5 inches in diameter makes 40 revolutions per minute. Find the cutting speed. What metal would this speed be suitable to cut?
3. An end mill is 1 inch in diameter and is to be used in milling cast iron. What should be the revolutions per minute of mill?
4. An end mill is $\frac{3}{8}$ inch in diameter and is to be used in milling soft steel. What should be the revolutions per minute of the mill?
5. A spiral mill $2\frac{1}{2}$ inches in diameter makes 150 revolutions per minute. Find the cutting speed. What metal would this speed be suitable to cut?
6. A milling cutter is 6 inches in diameter and is to be used in milling bronze. What should be the revolutions per minute of the cutter?
7. What would be the proper revolutions per minute of a milling cutter $3\frac{1}{2}$ inches in diameter for milling tool steel?

LESSON 3

Cutting feeds

The feed for work on the milling machine depends largely upon the pitch and clearance of the teeth of the cutter and also upon the kind of material to be milled. Generally, roughing cuts should be taken with coarse-pitch cutters running at slow speed with a heavy feed and with never more than two or three teeth cutting at one time. Finishing cuts should be taken with fine-pitch cutters at a fast speed and light feed.

Cutters are very seldom ruined by feed, but are often ruined by being run at too high speed. Much more damage is done to the cutter by taking a scraping cut than by taking a heavier chip.

The following is a table of feed in inches per minute:

Tool steel (annealed).....	6-10 to 8-10
Soft steel.....	8-10 to 1
Cast iron.....	$1\frac{1}{4}$ to 3
Brass.....	2 to 4
Bronze.....	$1\frac{1}{2}$ to 3

NOTE.—This table is based on the use of a 20-tooth cutter and a minimum chip of 0.0015 thick for tool steel. Feed is easily figured by determining the number of threads per inch of the lead screw and the number of revolutions the feed screw makes per minute. If there are five threads per inch on the feed screw, then the distance the screw advances in one turn would be one-fifth of an inch, and if the feed screw makes 10 revolutions per minute, the advance of the table, which is moved by the feed screw, would be $\frac{1}{5} \times 10 = 2$ inches feed per minute.

Problem

1. The feed screw of a milling machine has four threads per inch and the screw makes six turns per minute. What would be the feed per minute? What metal would this feed be suitable for?
2. The feed screw of a milling machine has four threads per inch. How many revolutions per minute must it make to give a feed of 2 inches per minute?
3. The feed screw of a milling machine has four threads per inch and makes $1\frac{1}{2}$ revolutions per minute. How many minutes would it require to mill a surface 8 inches in length?
4. Suppose the feed screw of a milling machine has four threads per inch and it takes 12 minutes to mill a surface 9 inches long. How many revolutions per minute would the screw have to make?
5. The feed screw of a milling machine has five threads per inch and makes $2\frac{1}{2}$ revolutions per minute. How many minutes would it require to mill a surface 15 inches long?

LESSON 4

Simple indexing

Indexing is a process devised to make accurate dividing of a circumference possible. Note the above picture of a dividing head; study the trade names of important parts. Now

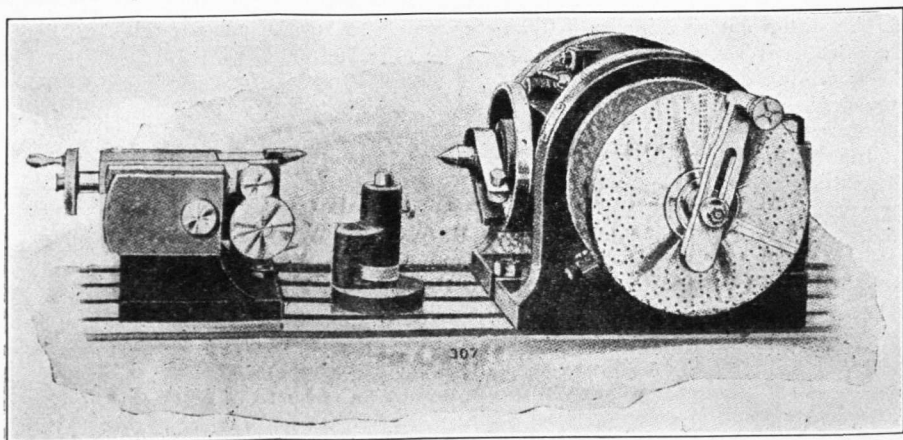


FIG. 4

go to your milling machine and ask the instructor to explain the use of the dividing head; grasp the index pointer, slightly pulling toward you until the pointer is free to revolve. Revolve this index crank; note what happens to the dividing head spindle. The standard index head requires 40 turns of the index pointer to make one turn of the dividing head spindle.

The parts with which you must deal in making divisions are direct index plate and pointer or the index plate and index crank. The direct index plate and pointer are sometimes used when there are many pieces requiring the same indexing to be done and there is a circle of holes which will meet the requirements; in all other cases the index plate and index crank are used.

Rule

Divide the number of turns the index pointer makes while revolving the dividing-head spindle one revolution by the number of divisions desired. Select the largest circle on the index plate that is divisible by the denominator of the fraction.

NOTE.—It is good practice to use the largest circle possible, as the possibility of error is reduced; also by having the index crank extended it is much easier to turn.

Example

Let 40 be the number of turns the index pointer makes to one revolution of the dividing-head spindle.

1. Required to cut a milling cutter of 20 teeth, then $\frac{40}{20}=2$ turns on any circle.
2. Required to cut an end mill of six teeth, then $\frac{40}{6}=6\frac{2}{3}$ turns, or 6 turns and two-thirds of another turn on any circle divisible by 3. Thus, if the 33 circle is used the indexing would be 6 turns and 22 holes.

Number of holes in index plates:

No. 1—15-16-17-18-19-20.

No. 2—21-23-27-29-31-33.

No. 3—37-39-41-43-47-49.

NOTE.—The above index plates are furnished with one of the standard makes of milling machines, but as there are many manufacturers a different series of plates is likely to be encountered with different machines, but the method of computing the indexing is the same for all.

Problems

1. What indexing would you use in milling an end mill of 14 flutes?
2. What indexing would you use in milling a milling cutter of 26 teeth?
3. What indexing would you use in milling a cutter of 12 flutes?
4. You are to cut a gear of 54 teeth. What indexing are you going to use?
5. You are required to graduate 360 divisions on a steel collar. What indexing will you use?
6. You are required to make a ratchet of 180 teeth. What indexing will you use?
7. You are required to drill eleven $\frac{1}{4}$ -inch holes in a disk, which you will hold in the chuck to be screwed on a dividing-head spindle; the dividing head will have to be turned around on a table and placed perpendicular to it. What indexing will you use?

LESSON 5

Simple indexing angular measure

In many cases it is necessary to compute indexing in the terms of circular measure in combination with divisions. For example, in making cams for uniform or variable motion.

Example

Required to make a heart-shaped cam to develop uniform motion with a throw of 0.360 of an inch in 180° .

There are 360° in a circle, and if we should take a cut every 5° we would have to index for 72 divisions. Use circle 27 and index 15 holes for each cut;

after the first the table must be lowered to $\frac{1}{36}$ (one-half of the number of divisions), or 0.360 or 0.10 for each cut.

NOTE.—Five degrees spacing is near enough for roughing out a cam, but for finishing, if the cam is very accurate, a male radius cutter of the same radius as the roll which is to follow the cam should be used and the spacing should be for each degree and the table lowered accordingly. Always choose an index circle, when possible, that will give the rise to each division in thousandths of an inch.

Problems

You are required to mill a cam according to sketch. To develop uniform motion with a throw of 0.500 in 180° the cam roll is 0.375 in diameter. What cutter would you use? What indexing will you use? How much will you lower table for each division? What difference will there be in your work when milling return side? What must you look out for in lowering table to make sure you get correct measurement?

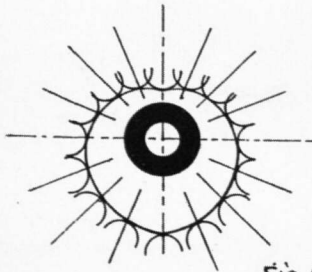


Fig 6

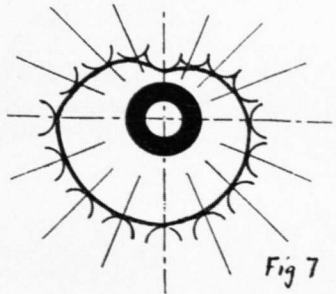


Fig 7

You are required to mill a cam according to sketch, to develop variable motion with a throw of 0.375 in 90° , 0.250 in the next 90° , and to remain at maximum through next 90° and return to zero or starting point in next 90° . What indexing will you use? How much will you lower table for each division? What difference will there be in your work when milling the return side?

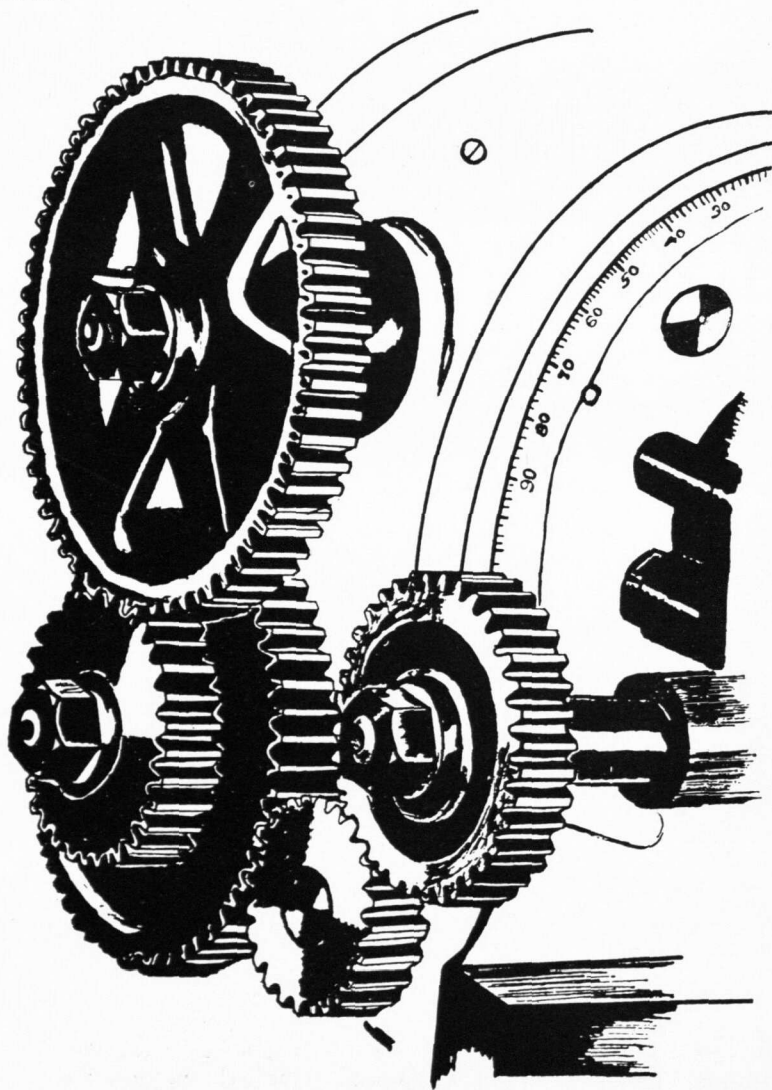


FIG 8.

LESSON 6

Differential indexing

It sometimes happens that a number of divisions is required for which there is no index plate which will permit the correct indexing. In such cases a process of differential or compound indexing may be used, but as differential indexing is the type usually used on account of its simplicity and distinct advantages we will now get acquainted with the process.

Differential indexing is a process of indexing through the use of an index plate connected to the dividing-head spindle by means of change gears.

The index plate is revolved by the train of gears shown in Figure 8, the back pin being removed from the index plate to allow it to revolve freely. It may be revolved in the same or opposite direction by inserting idler.

If the index plate is stationary, the index crank will have to pass any given point on the plate 40 times to give one complete turn of the dividing-head spindle. Suppose that the train of gears would cause the plate to make one revolution in 39 turns of the index pointer, then the index crank would have to pass any given point on the index plate only 39 times, as the extra revolution of the index plate would make the fortieth revolution.

Example

Required to cut a gear of 51 teeth. What indexing will you use? As in simple indexing, place 40 as the numerator of fraction and the number of divisions (51) as the denominator $\frac{40}{51}$. Now, as we have no index circle with 51 holes, we select a fraction the value of which is approximately $\frac{40}{51}$, namely, $\frac{17}{42}$; we can use any circle that is divisible by the denominator (17) of the approximate fraction. Suppose we select circle 17, then the index pointer will move $\frac{17}{42}$ of 17 holes, or 14 holes to each indexing, but by this indexing we would not cut the required 51 teeth; therefore, we must revolve our index plate through a train of gears to give the correct spacing for 51 divisions. We have used the fraction $\frac{17}{42}$ for our regular indexing; we must, therefore, use this same fraction to determine the ratio of gears to use; therefore, $\frac{17}{42}$ of 51 divisions equals 42 complete turns, or 2 turns more than the 40 required to turn dividing-head spindle 1 complete turn. Then by using gears in the ratio of 2 to 1, the 42 turns of the crank will make the required 40 turns

$$\frac{2}{1} \times \frac{24}{24} = \frac{48}{24} \text{ gear on spindle.}$$

$$\frac{1}{1} \times \frac{24}{24} = \frac{24}{24} \text{ gear on worm.}$$

Problems

1. You are required to cut a ratchet with 57 teeth. What indexing will you use? What gears will you use on spindle, worm, first gear on stud, second gear on stud?
2. You are required to cut a gear of 61 teeth. What indexing will you use? What gears will you use on spindle, worm, first gear on stud, second gear on stud?
3. You are required to cut a gear of 99 teeth. What indexing will you use? What gears will you use on spindle, worm, first gear on stud, second gear on stud?
4. You are required to drill an index plate with 105 holes. What indexing will you use? What gears will you use on the spindle, worm, first gear on stud, second gear on stud?
5. You are required to graduate a disk with 53 divisions. What indexing will you use? What gears will you use on spindle, worm, first gear on stud, second gear on stud?

LESSON 7

Compound indexing, exact

Compound indexing is often used in shops where there is no milling machine equipped for differential indexing and where it is required to do a job where simple indexing can not be used; however, differential indexing should always be used in preference to compound indexing when possible.

In compound indexing, not only is the index crank moved, but the index plate is also moved. In order to move the index plate an exact angular distance, the back pin is withdrawn from the outer row of holes, the plate is turned forward or back the required number of spaces, and the back pin is again inserted. This is done with the index pin in place in the plate; consequently when the plate is moved the worm shaft is moved through the same angular distance as the plate. After moving the plate, the index pin is withdrawn from a hole in one of the inner rows, moved the proper number of spaces, and again inserted into a hole. Each time that an indexing operation is performed the index pin is moved a certain number of spaces in an inner row and the plate is moved a certain number of spaces in the outer row. The angular movement of the worm shaft is then the sum or difference of the angular movements of the index pin and the plate.

Let us consider the movement of the worm shaft resulting from this.

Let A=number holes in circle in which back pin is inserted.

Let B=number holes in circle in which index pin is inserted.

Let P=number divisions in which work is to be divided.

NOTE.—A backward movement will be designated by a minus (−) sign and a forward movement will be indicated by a plus (+) sign. If the plate is moved backward one space using back pin, the worm shaft will make $-\frac{1}{A}$ revolutions. If the index crank is moved forward one space, the worm shaft will make $+\frac{1}{B}$ revolutions. When both of these operations have been performed, the worm shaft will have made $\frac{1}{B} - \frac{1}{A} = \frac{A-B}{AB}$ revolutions. The work will then make one-fortieth of this number, which is $\frac{A-B}{40 AB}$ revolutions. It is desired that each time the work is indexed it shall make $\frac{1}{P}$ revolutions. In order to do this we will move the plate back N spaces and the index crank forward N spaces. This will turn the worm shaft N times as far as it would turn if the plate and index crank were each moved one space; consequently we may write

$$N = \frac{A-B}{40 AB} = \frac{1}{P}$$

Solving for N we will have

$$N = \frac{40 AB}{P (A-B)}$$

In the above equation A, B, and P are integers. In order that the indexing may be exact, it is necessary that N shall also be an integer; consequently, 40 AB must be exactly divisible by P (A−B). In order to make this true, it is apparent that for every factor in P (A−B) there must be a corresponding factor in 40 AB. The product of the remaining factors in 40 AB will obviously be the quotient of $\frac{40 AB}{P (A-B)}$, which is N.

Compound indexing—Rules for compound indexing

First, factor P.

Second, choose two index circles containing these factors.

Third, factor A−B, and write the factors of P and those of A−B to the left of a vertical line.

Fourth, write the factors of 40, of A and of B to the right of this line.

Fifth, cancel equal factors on the left and right of the line. All of the factors on the left of the line must cancel if the work is to advance one division for each indexing operation. All of the factors of P must cancel in any event, but factors of A−B, which are not factors of P, need not cancel. In case such uncanceled factors remain, the work will be advanced a number of divisions equal to the product of these uncanceled factors each time that an indexing operation is performed.

Sixth, the product of the uncanceled factors to the right of the line will be the number of holes which the plate must be turned back and the index crank forward.

Example

In order to illustrate the method of using this rule, let us divide a circle into 69 parts. Since the factors of 69 are 3 and 23, the 23-hole circle must be chosen and another circle whose number of holes is exactly divisible by 3. A 33-hole circle is the outer circle on the plate containing the 23-hole circle. We may, therefore, write our factors as follows and cancel:

$$\begin{array}{ll} P=69=3 \times 23 & 40=2 \times 2 \times 2 \times 5 \\ 33-23=10=2 \times 5 & A-33=3 \times 11 \\ & B-23=23 \end{array}$$

Problems

1. You are required to cut a gear of 63 teeth. What index circles will you use? What indexing will you use? What indexing will you make?
2. You are required to graduate a disk of 111 divisions. What index circle will you use? What indexing will you make?
3. You are required to cut a gear of 117 teeth. What index circle will you use? What indexing will you make?
4. You are required to drill 93 holes in an index plate. What index circles will you use? What indexing will you make?
5. You are required to gash a worm gear of 81 teeth. What index circles will you use? What indexing will you make?

LESSON 8

Approximate compound indexing

In the case of all prime numbers greater than 47, and in the case of many composite numbers, it is necessary to resort to a system of approximate division. The division will necessarily be approximate when all of the factors in the number to be indexed and in the differences between the number of holes in the two circles (with the exception noted) can not be canceled by the factors of 40 and of the number of holes in the two circles. In order to illustrate the method of approximate indexing, and also to develop the theory for approximate indexing, we will attempt to divide a circle into 51 parts.

Since 51 is a prime number, we can not find two circles which will perform the indexing exactly. We will accordingly solve for N, taking the 49 and 47 hole circles. Solving, we have

$$N = \frac{40 \text{ AB}}{P(A-B)} = \frac{40 \times 49 \times 47}{51(49-47)} = 903 \frac{14}{102}$$

The dial must, therefore, be turned back 903 holes and the index crank forward the same number of holes each time that the indexing operation is performed. Dividing 903 by 47, and also by 49, we find that the index plate must be turned back $18\frac{21}{47}$ turns and the index crank must be turned forward $19\frac{19}{49}$ turns. Dropping 18 complete turns in each case, we have the dial turned back 21 spaces and the index crank forward one turn and 10 spaces. Each time that the indexing operation is performed the worm shaft is advanced $1\frac{9}{47} - \frac{21}{49} = \frac{133}{2203}$ revolutions. The work is advanced to $\frac{1}{47}$ of this amount, or $\frac{1806}{92120}$ revolutions.

When 51 indexing operations have been performed, the work will have advanced

$$\frac{51 \times 1806}{92,120} = \frac{92,106}{92,120} \text{ revolutions.}$$

In 51 indexing operations we will, therefore, be short $\frac{14}{92120}$ revolutions of a complete revolution of the work. Assume that a gear is being cut whose pitch diameter is 10 inches. Then its circumference will be 31.416 inches. The last tooth will be thicker than it should be by

$$\frac{14 \times 31.416}{92,120} = 0.0048 \text{ inch.}$$

For gear cutting this error is so large as not to be permissible. If it is desired to reduce this error, it may be done by cutting every seventh tooth and indexing seven times around the work until all of the teeth have been cut. The reason for this is that the exact value of N (the number of spaces which the index pin must be advanced and the dial plate turned back) is $903\frac{14}{102}$. Since $\frac{14}{102}$ is nearly $\frac{1}{7}$, we may multiply the exact value of N by 7 and obtain $903\frac{14}{102} \times 7 = 6,321\frac{98}{102}$. This is within $\frac{4}{102}$ of 6,322. Consequently, if we turn the dial and the index pin 6,322 spaces each time that we perform an indexing operation, the seventh tooth will be out of place by a less amount than the first tooth would be had we turned each 903 spaces.

The advisability of cutting every seventh tooth lies in this: In cutting seven teeth correctly we should advance $6,321\frac{9}{10}$ spaces. If we advance 903 spaces each time an indexing operation is performed, after seven indexing operations we will have advanced 6,321 spaces, whereas we should advance almost, but not quite, 6,322 spaces. Accordingly, by advancing 6,322 divisions each time we will be nearer than we would be if we advanced only 903 spaces.

It is, however, possible to divide the circle even more accurately in the following manner: Multiplying $903\frac{1}{10}$ by 22, we obtain as the product $19,869\frac{2}{10}$. The nearest integer is 19,869, and the difference between this and the true value, $19,869\frac{2}{10}$, is only $\frac{2}{10}$, which is less than was the case when N was multiplied by 7. Dividing 19,869 by 47 and 49, we will have for the quotients $422\frac{3}{47}$ and $405\frac{2}{49}$. Consequently, in order to advance the work 22 divisions we must turn the index crank forward $17\frac{3}{47}$ turns and the dial plate back $\frac{2}{49}$ turns.

It will be noted that the dial plate is turned back 24 spaces and the index crank forward $17\frac{3}{47}$ turns, which is 834 spaces. Both these numbers are divisible by 2, as is also 22. Consequently, if we advance the index crank half the distance, or 417 spaces, and turn the dial plate back half the distance, or 12 spaces, we will have advanced the work 11 instead of 22 divisions. We will accordingly turn the index crank forward $8\frac{1}{47}$ turns and the dial plate backward $\frac{1}{49}$ turn. By doing so we will cut every eleventh tooth in the gear, and by continuing 11 times around the circle will finally arrive almost at the starting point after performing 51 indexing operations.

The determination of errors

The error may be determined as follows:

Each time an indexing operation is performed the worm shaft is advanced

$$8\frac{1}{47} = \frac{1}{47} = \frac{1}{2 \times 23 \times 3} \text{ turns}$$

The work is advanced $\frac{1}{49}$ of this amount, which is $\frac{1}{98 \times 23 \times 3}$ turns. In 51 indexing operations the work is advanced

$$\frac{19,869 \times 51}{92,120} = \frac{1,013,319}{92,120} \text{ turns}$$

which is $\frac{1}{98 \times 23 \times 3}$ turns short of 11 complete revolutions. In this case the last tooth cut in a 10-inch pitch diameter gear will be thicker than it should be by

$$\frac{1 \times 31,416}{92,120} = 0.00034 \text{ inch.}$$

This is the greatest error in the gear. The other teeth will usually be thinner than they should be, while every eleventh one will be thicker than it should be.

Notation

A—Number holes in circle in which back pin is inserted.

B—Number holes in circle in which index pin is inserted.

P—Number divisions in which work is to be divided.

I—Indexing.

Example

Required to cut a gear 10 inches pitch diameter, 83 teeth.

$$I = \frac{40 \text{ AB}}{P (A - B)} = \frac{40 \times 49 \times 47}{83 (49 - 47)} = \frac{46060}{83} = 554\frac{8}{83}$$

$$554\frac{8}{83} = 555 \text{ approximately.}$$

$$\left. \begin{array}{l} 555 \div 47 = 11\frac{3}{47} \\ 555 \div 49 = 11\frac{1}{49} \end{array} \right\} \text{Less } 11 = \left\{ \begin{array}{l} \frac{3}{47} \text{ Indexing on } 47 \text{ circle.} \\ \frac{1}{49} \text{ Indexing on } 49 \text{ circle.} \end{array} \right.$$

Check.

$$\frac{38}{47} - \frac{16}{49} = \frac{1862}{2303} - \frac{752}{2303} = \frac{1110}{2303}$$

$$\frac{1110 \times 83}{2303 \times 40} = \frac{92130}{92130}$$

$$10'' \text{ dia.} = \frac{10 \times 31.416}{92120} = \frac{31.416}{9212} \quad .0034 \text{ error}$$

$$\begin{array}{l} 79 \text{ divisions. } 49 + 47 \text{ circle used} \\ \frac{40 \times 49 \times 47}{79 \left(\frac{4}{3}\right)} = \frac{46060}{79} = 583\frac{8}{9} \end{array}$$

When the example is finished this way it develops an error of 0.00204, which is too much. To split up the error the following method is used:

$$\begin{array}{l} \frac{8}{9} = \text{practically } \frac{1}{2} \\ 583\frac{8}{9} \\ 26 \\ \hline 15158\frac{8}{9} \end{array} \quad \text{Call it } 15159 \div 47 \text{ and } 49$$

$$\begin{array}{r} 322\frac{2}{4} \\ .47) 15159 \\ 309\frac{1}{4} \\ \hline 49) 15159 \end{array}$$

$$\frac{322\frac{2}{4}}{13\frac{1}{4}} = 636/47 = \frac{31164}{2303} - \frac{846}{2303} = \frac{30318}{2303}$$

$$\frac{18}{49} = \frac{346}{2303} \quad \begin{array}{l} \text{Common} \\ \text{Denominator} \end{array}$$

$$\begin{array}{l} \text{Number of Divisions} \quad \frac{2}{26} \quad \frac{2}{92120} = \frac{2}{92120} \text{ too much} \\ \frac{30318}{2303} \times \frac{79}{40} = \frac{2395122}{32120} = 92120) 2395122 \end{array}$$

40 turns for 1 revolution.

$$\begin{array}{l} \frac{2 \times 31.416}{.0006} = \frac{62.832}{92120} \\ 92120) 62.832 \text{ error} \end{array}$$

Problems

1. You are required to mill a ratchet of 77 teeth and the maximum error allowed is .0015. What index circles will you use? What indexing will you make?
2. You are required to cut a gear 5.3 inches pitch diameter 53 teeth. What index circle will you use? What indexing will you make so as to have an error of not over 0.0005?

LESSON 9

Spiral milling, shop method

The lead of a spiral is the distance it advances in making one complete revolution.

The lead of a milling machine is determined by placing equal gears on the worm and feed screw and placing gears of same size on first and second gears on stud, as it is necessary to have gears in complete mesh from feed screw to worm. Then by multiplying the number of revolutions made by the feed screw while producing one complete revolution of the dividing-head spindle by the lead of the feed screw will give the lead of the machine.

Suppose it is necessary to make 40 revolutions of the feed screw in order to turn the index-head spindle one complete revolution when the gears are the same size and the lead of the feed screw of the milling machine is $\frac{1}{4}$ inch, then the lead of the machine equals 40 times $\frac{1}{4}$, or 10 inches. Formula:

$$\frac{\text{Lead of spiral to be cut}}{\text{Lead of machine}} = \frac{\text{number of teeth in gear on worm stud}}{\text{number of teeth in gear on feed screw}}$$

Compound gearing—Rule

The rule is the same for the milling machine as it is for the engine lathe, and when it is expressed as a formula would read as follows:

$$\frac{\text{Lead of machine}}{\text{Lead of spiral to be cut}} = \frac{\text{product of driving gears}}{\text{product of driven gears}}$$

Number of teeth gear furnished with milling machines for spiral cutting—24-28-32-40-48-56-64-72-84-96-108.

Example

It is required to cut a spiral of 36 inches lead on a milling machine with a 10-inch lead. What gears can be used? Formula:

$$\begin{aligned} \frac{\text{Lead of machine}}{\text{Lead of spiral}} &= \frac{10}{36} \\ \frac{10}{36} &= \frac{2 \times 5}{4 \times 9} \\ \frac{2}{4} \times \frac{16}{16} &= \frac{32 \text{ driver}}{64 \text{ follower}} \\ \frac{5}{9} \times \frac{8}{8} &= \frac{40 \text{ driver}}{72 \text{ follower}} \end{aligned}$$

Then either the 32 or 40 gear can be used on the feed screw; but in practice the larger is usually used. Also, either the 64 or 72 gear can be used on the worm; but in practice the larger is usually used. Suppose we use the 40-tooth gear on the feed screw and the 72-tooth gear on the worm; then we will have the 32-tooth gear, which is a driver, and the 64-tooth gear, which is a follower, left to be placed on the stud, but as the 32-tooth gear is a driver, it must be placed as the first gear on the stud, as it must mesh with the gear on the worm. We now have one more gear which we have not used—namely, the 64-tooth gear, which is a follower, and consequently must be placed as the second gear on stud to mesh with the gear on the lead screw. If, after getting these gears all in mesh and in revolving the feed screw the dividing-head spindle should turn in the opposite direction from what is required, it is only necessary to introduce an equal gear between the first gear on stud and the gear on the worm.

NOTE.—Before trying to revolve the dividing-head spindle through this train of gears the back pin inserted in index plate or any other method of fastening the plate to keep from revolving must be removed so that plate will revolve freely.

As the lead of a spiral forms an angle with the length of the piece of work on which it is cut, and as it is necessary that the cut in the work should conform to the shape of the cutter used in making the cut, it is necessary that the table should be turned to an angle when the spiral cut is taken.

Example

Find the angle to set the milling-machine table when cutting a spiral with a lead of 36 inches on a cutter $4\frac{3}{8}$ inches diameter, the depth of tooth to be $\frac{3}{8}$ inch.

Draw a right triangle with a base equal to the lead of the spiral (36 inches) and an altitude equal to the mean circumference of the work, the pitch circumference in gears. Then the angle A is the required angle to set the table of the milling machine. To determine the number of degrees in this angle, we place the straight side of a protractor on the base line with the center mark at A, the intersection of the two lines. Then we can read the number of degrees in the angle from the graduates scale of protractor where the line A B intersects.

NOTE.—The mean diameter is obtained by subtracting the depth of the cut from the outside diameter of the cutter.

Problems

1. You are required to mill a spiral cutter $2\frac{1}{2}$ inches diameter 20 teeth, 42 inches lead, and the depth of tooth to be $\frac{1}{4}$ inch and the lead of machine is 10 inches. What indexing will you make? What gears will you use on the lead screw worm—first gear on stud, second gear on stud? What angle will you set the table?

2. You are required to mill a spiral cutter $3\frac{3}{4}$ inches diameter 24 teeth, 25 inches lead, the depth of tooth $\frac{3}{8}$ inch, and the lead of machine 10 inches. What indexing will you use? What gears will you use on lead screw worm—first gear on stud, second gear on stud? What angle will you set the table?

3. You are required to cut a spiral end mill $1\frac{1}{4}$ inches diameter 14 teeth, 16.87 inches lead, and the depth of tooth to be $\frac{3}{16}$ inch and the lead of machine 10 inches. What indexing will you use? What gears will you use on lead screw worm—first gear on stud, second gear on stud? What angle will you set the table?

4. You are required to cut a spiral gear 17 teeth, with a pitch diameter 1.215 inches, the angle of spiral 45° and the lead of machine 10 inches. What indexing will you use? What will be the lead of spiral? What gears will you use on lead screw worm—first gear on stud, second gear on stud? What angle will you set the table?

5. You are required to cut a spiral gear 24 teeth, with a pitch diameter 2.4 inches, the angle of spiral 30° , and the lead of machine 10 inches. What indexing will you use? What will be the lead of spiral? What gears will you use on lead screw worm—first gear on stud, second gear on stud? What angle will you set the table?

LESSON 10

Spiral milling mathematical method

A considerable saving of time can be effected in solving spiral milling problems if the operator has a working knowledge of the solution of triangles and the use of trigonometric functions. We will therefore endeavor to become familiar with the use and application of trigonometric functions as applied to cutting spirals on the milling machine. We will start by drawing a right triangle, as in Lesson 9, with a base equal to the lead of the spiral to be cut and an altitude equal to the mean circumference of cutter. Letter the triangle so that A represents the angle; O represents the side opposite the angle; A represents the side adjacent to the angle, and h represents the hypotenuse. Then tangent of an angle ($\tan. A$)

equals side opposite (o) divided by side adjacent (a) $\tan. A = \frac{o}{a}$.

Substituting figures for letters, we have

$$\tan. A = \frac{12.5664}{36} = .3491$$

Look in the table of tangents and find the value of an angle for a tangent of 0.3491, and we find it to be $19^\circ 15'$ (19 degrees 15 minutes), or $19\frac{1}{4}^\circ$, which is the angle to set the table.

Formula:

$$\frac{3.1416 \times \text{dia.}}{\tan. \text{ of } L} = \text{lead}$$

$$\frac{3.1416 \times \text{dia.}}{\text{lead}} = \tan. \text{ of angle}$$

Example

Required to cut a spiral gear 2 inch pitch diameter at 45° angle, what will be the lead?

$$\frac{3.1416 \times 2}{\tan. 45^\circ} = \frac{3.1416 \times 2}{1} = 6.2832$$

Problems

1. You are required to cut a spiral cutter $4\frac{1}{2}$ inches diameter 28 teeth, and the cut to be $\frac{3}{8}$ inch deep and lead of spiral 41.14 inches. What indexing will you use? What gears will you use on lead screw worm—first gear on stud, second gear on stud? What angle will you set table?

2. You are required to cut a spiral gear of 35 teeth 3.5 inches pitch diameter at 30° angle. What indexing will use use? What is the lead of spiral? What gears will you use on lead screw worm—first gear on stud, second gear on stud? What angle will you set table?

3. You have been given a worn-out 16-tooth spiral cutter, which has been annealed to recut and you have found that it is $2\frac{1}{2}$ inches diameter. But the problem faces you as to how to find out what the lead of the old teeth are so as to be able to recut the teeth with the same lead. All that is necessary is for you to get a piece of clean paper and place it on a level place. Next get a piece of wood, steel, or other material from $\frac{1}{4}$ to 1 inch thick, with one edge straight (straightedge). Now lay this straightedge on paper and draw a line along the straight side, being careful to let straightedge remain in position on line. Now ink or oil the teeth of cutter so that when it comes in contact with the paper it will leave an impression of the tooth. After teeth are prepared in this way hold the straightedge rigidly in position with left hand and hold end of cutter against straightedge, slightly pressing cutter on the paper and rolling it along the straightedge. You then produce the effect shown in illustration, and by completing your triangle as shown in the sketch, and by continuing the line along the straightedge from A in a straight line a distance equal to the circumference of the cutter ending at B then at B draw a line of indefinite length perpendicular to line A B. Then by drawing a line through the impression of tooth from A to a point of intersection on the perpendicular line at C you will have established the length of the line B C, which is the required lead of spiral. The scale of sketch is $\frac{1}{32}$ inch to an inch. What is the lead? What gears will you use on lead screw, worm, first gear on stud, second gear on stud? What angle will you set table?

4. Get a cutter from the shop and determine the lead of spiral, the angle to set table, and the gears to use in cutting same.

Rehabilitation monograph. Joint Series No. 49.

Unit Course—Bookkeeping 2—Instructor's Guide for Unit Course

BOOKKEEPING

February, 1919—Trial edition

RETAIL BUSINESS IN DOUBLE ENTRY FOR PROFESSIONAL ACCOUNTANTS

A. QUALIFICATIONS OF STUDENTS

This course is intended for men having at least a grammar-school education or its equivalent, who have completed unit 1 or its equivalent either by study or through experience in business.

B. AIM OF COURSE FOR STUDENTS

It provides such training in bookkeeping and business practice as will enable the student to keep a simple set of books comprising the journal, sales book, purchase book, cash book, and ledger; to prepare simple profit-and-loss statements and balance sheets, and to use intelligently such business papers as checks, notes, drafts, receipts, invoices, statements, orders, and telegrams, and to keep an account with a bank. This unit gives practice in keeping a set of books for a business with a single proprietor.

The kind of business illustrated by the set of books kept in this unit will depend upon the textbook selected. If in studying this unit one wants to keep a special set of books such as would serve for the retail grocery business, for example, he must select the text giving that type of business. (See list of textbooks, p. 3.)

To those who intend to become professional bookkeepers the type of business selected—grocery, dry goods, hardware, etc.—will make little difference, because the transactions relating to a particular business merely serve as a medium for teaching the general principles of bookkeeping or accounting. The special information given in connection with a particular type of trading business will have some slight value to one entering that business.

In the lists of textbooks (pp. —) several different types of business are given with the intent that the line of greatest interest to the student can be selected. If the student is familiar with the terms and transactions common to the business, he is then free to concentrate his attention upon the accounting problems and principles.

C. APPROXIMATE TIME

This unit course can be completed by an average student in approximately 50 hours. The time allotment will vary between 40 hours and 60 hours, depending on the text material selected for presenting this information and the quantity of supplementary practice.

D. EQUIPMENT

The student now handles five blank books and several business papers as well as his textbook, therefore ample desk space is desirable. If possible, a desk or table not less than 18 inches deep and 24 inches wide should be provided.

(a) *Paper*.—The quantity and kind of paper required will be indicated under (g) for each of the textbooks.

(b) *Pencils*.—One No. 2 lead pencil.

(c) *Pens*.—A good fountain pen or a penholder with a large base and six steel pens (business or school points) should be provided.

(d) *Ruler*.—A good ruler 12 inches long, with a brass or other metal edge, is a necessity.

(e) *Ink*.—A bottle of black or blue writing fluid is best. All ruling may be done in black ink, thereby dispensing with the use of red ink.

(f) *Blotter*.—A small hand blotter is indispensable.

(g) *Textbooks*.—Some standard textbook will be necessary to give the instruction of this unit. Each text listed below is accompanied by sets of actual vouchers, thus lending considerable interest for the student. The work of this unit course can be covered by the use of any one of the texts and its accompanying material.

The textbooks and practice material are listed under the authors' names, which have been arranged alphabetically. A brief description of the work to be done and the approximate number of hours required to complete the practice work is included under each text.

E. LIST OF TEXTBOOKS

(Arranged alphabetically)

1. James W. Baker, *Twentieth Century Bookkeeping and Accounting*, South-Western Publishing Co., Cincinnati, Ohio.

Material required:

1 textbook, *Twentieth Century Bookkeeping and Accounting*.

3 packages containing business transactions for January, February, and March, No. 102.

1 package No. 103 Stationery, Part I.

1 set blank books.

15 double sheets journal paper.

15 double sheets ledger paper.

10 sheets ruled paper about letter size.

The above material provides for a set of books representing the retail grocery business.

Instruction is given by means of instruction sheets and copies of business papers consisting of invoices, checks, notes, drafts, receipts, bills of lading, orders, statements, telegrams, etc., which are contained in 24 envelopes, divided into three periods of one month each. The textbook discusses principles and furnishes the necessary forms for preparing balance sheets and profit-and-loss statements. The business papers and transactions are those found in the retail grocery business and include the keeping of a bank account by means of a bank book and check books.

In the text, begin on page 47 and continue to page 96. Several exercises appear under each of the new books and accounts introduced. In many cases the student will understand the topic after working one exercise, and some few students may omit all the exercises provided in the text. But every student must use the material in the envelopes.

Approximately 60 hours will be needed for this work.

2. Ellis, Ellis Industrial Bookkeeping. Revised Edition, Ellis Publishing Co., Battle Creek, Mich.

Material required:

- 1 textbook, Guide to Ellis Industrial Bookkeeping, revised.
- 1 business directions, section 1.
- 1 outfit, beginning section.
- 1 set blank books.
- 1 teacher's key.
- 1 hard lead pencil.
- 5 double sheets journal paper.

This textbook gives a set of books representing the jobbing produce and provision business. This is a continuation of the same material used in unit 1, therefore it will be advisable not to begin the work here, but to start the student with unit 1 and continue through unit 2 and unit 5 with the same material. All the usual business papers will be dealt with in this unit.

3. Lloyd E. Goodyear, American Bookkeeping Series. Goodyear-Marshall Publishing Co., Cedar Rapids, Iowa.

This company furnishes material in small pamphlets called units. The two units listed here provide practice in recording transactions in the journal, sales book, purchase book, and cash book. Select one.

Unit 4 (without business papers)

Material required:

1 copy principles, rules, and definitions for bookkeeping.....	\$0. 60
1 copy unit 4.....	. 40
1 copy quiz book.....	. 10
1 copy teacher's key.	

The above unit gives a set of books representing the retail coal business. A preliminary set introducing the various books or original entry precedes the set on the retail coal business, illustrating the use of the "order book" for sales in the coal business. Approximately 40 hours will be required to complete this unit.

Unit 4 A (with business papers)

Represents the books of a jobbing grocery business (wholesale).

Material required:

1 copy principles, rules, and definitions for bookkeeping.....	\$0. 60
1 copy unit 4 A.....	. 90
1 quiz book.....	. 10
1 teacher's key.	

This unit begins with a short problem—without business papers—in which the usual journals (general, sales, purchases, and cash) are introduced in a retail coffee, tea, sugar, and sundries business.

The principal problem consists of a jobbing grocery business (wholesale) which provides for the use of the usual business papers, both incoming and outgoing, and a bank account kept by means of a bank book and check book.

Approximately 60 hours will be needed for this unit.

If Goodyear's unit 1 and unit 2 were used in the preliminary work in our unit 1, the student should first complete Goodyear's unit 3.

4. Miner and Elwell, Principles of Bookkeeping, First Course, Ginn & Co., New York.

Material required:

- 1 textbook, Principles of Bookkeeping. First Course.
- 1 box A business forms for Sets III and IV.
- 1 set blank books.
- 1 teacher's key.
- 10 double sheets journal paper.
- 5 double sheets ledger paper.
- 10 sheets ruled paper about letter size.

The above material provides for a set of books on the wholesale grain and seed business. The work in this text may be done either with or without the use of business papers, as all the material in the set is included in the text. A tablet, separate from the text, contains all the incoming business forms. The bank account is taught by means of a bank book, check book and deposit tickets. The student will prepare all outgoing business forms on the blanks provided.

The work of this unit is Set III and consists of transactions for two months. Begin on page 106 and continue to page 127 for the students' practice work. Pages 86 to 105 will be used in the preparation of the outgoing papers.

Consult Appendix D for "forms and legal documents" and Appendix E for "The use of telegrams."

This text does not discuss commercial drafts and bills of lading until the next unit is taken up.

Box A, business forms, contains sufficient material for unit 2 and unit 3.

Approximately 50 hours will be required to complete this work.

5. C. F. Rittenhouse, New Modern Illustrative Bookkeeping, Introductory Course, American Book Co., New York.

Material required:

- 1 textbook New Modern Illustrative Bookkeeping, Introductory Course.
- 1 set incoming vouchers April and May (revised).
- 1 set blank books.
- 1 set outgoing papers.
- 1 teacher's key.
- 10 double sheets journal paper.
- 10 double sheets ledger paper.
- 5 sheets ruled paper about letter size.

The above material provides for a set of books illustrating the wholesale flour, grain, and produce business.

This outfit provides instruction by means of textbook containing a series of business transactions, all the necessary forms and a discussion of principles. Two pads, covering two months of incoming vouchers, provide reproductions of actual business papers prepared by others. The student makes out the invoices, checks, notes, etc., which his firm gives to others. Entries in the various journals (general, sales, purchases, and cash) are made from the incoming vouchers and the business papers prepared by the student. The bank account is taught by using a bank pass book, deposit tickets, and a check book.

For this unit begin on page 85 of the text and end on page 107. Reference will be made to topics discussed on pages 50 to 84, inclusive.

Approximately 50 hours will be required to complete this work.

6. H. M. Rowe's Bookkeeping and Accountancy, The H. M Rowe Co., Baltimore, Md.

Material required:

- 1 textbook Rowe's Bookkeeping and Accountancy, No. 120A.
- 1 budget No. 121 elementary set.
- 1 set blank books No. 122.
- 1 set outgoing papers No. 123.
- 1 set envelopes No. 124.
- 1 teacher's key.
- 15 double sheets journal paper.
- 6 double sheets ledger paper.
- 5 sheets ruled paper about letter size.

The above material provides for a set of books on the wholesale provision business.

This is a continuation of the work offered in unit 1 by the same author. Instruction is given by means of a textbook containing discussions of the principles of bookkeeping and a budget holding all the incoming business papers and containing full instructions for the student. To do this work properly the student should begin with this material in unit 1; then this is merely a continuation, introducing the use of the check book and bank book in keeping a bank account and providing for a study of the ordinary business papers found in most businesses of this size.

For this unit begin on page 41 in the budget and complete on page 104. Business is conducted for two months, requiring the closing of the books and the preparation of financial statements.

Approximately 50 hours will be required to complete this material.

F. METHOD

The so-called business practice method will be followed because this material is immediately available with each text. In general it stimulates business conditions by requiring the student to keep a set of books for some particular business. Exercises consisting of transactions with actual or imaginary people and business houses, dealing in regular commodities of trade, are arranged chronologically and the student records the data as in a real business. Properly prepared business papers executed by others are furnished where necessary, and the student is required to prepare such business papers as his business would furnish to others.

In most instances it will be advisable to have the student use the same author's text and material for unit 2 as was used for unit 1.

In several of the outfits the instructor will find a number of selling prices for the commodities dealt in, with instructions to assign to each student a separate price list. These separate price lists are of doubtful value because they merely afford a check against the arithmetical work done by the student, while the important part of the work—the determining of correct debits and credits for the various accounts affected—is not stressed. The same price list should be assigned to each student, thereby saving the instructor much labor in examining papers. If the student is fairly accurate in his calculations the instructor can reduce the student's work by supplying him with the amount of each sale.

G. STANDARDS

Upon completing this course the student should be able to record a series of simple transactions for a trading concern in the following books: Journal, sales book, purchase book, cash book. He should be able to post from these books to the ledger, obtain a trial balance, close the ledger and prepare simple profit and loss statements and balance sheets.

In addition to this he should be able to write the following business papers: (a) Check; (b) promissory note; (c) receipt for money.

Rate on the following basis:

1. Accuracy in selecting the proper accounts to be debited or credited in the various books of original entry—the general journal, sales book, purchase book, and cash book.
2. Correct summary of the sales book, purchase book, and cash book preparatory to posting the totals of these books.
3. Indicating opposite each item in every account in the ledger the initial and page of the book of original entry from which the item was taken: "J" for the journal, "S" for the sales book, "P" for the purchase book, and "C" for the cash book.
4. Arrangement of information in the books of original entry.
5. Correctness of operations in closing the ledger at the end of a fiscal period.
6. Properly classifying assets, liabilities and capital in preparing the balance sheet.
7. Arrangement and grouping of items under appropriate headings in the profit and loss statement.
8. Neatness in arranging the material in the various books and statements. The student should be neat, even if his penmanship is poor.
9. Promptness in preparing and submitting assignments. Grade as follows:
A—Excellent, 90 to 100 per cent.
B—Good, 80 to 89 per cent.
C—Passing, 70 to 79 per cent.
D—Failure, under 70 per cent.

A SPECIMEN FINAL EXAMINATION FOR UNIT 2 (Time—two hours)

This examination will serve for any text which has been studied.

Material required:

- 1 Double sheet of journal paper.
- 1 Single sheet of journal paper.
- 1 Single sheet of ledger paper.

PART 1 OF THE EXAMINATION

NOTE.—Solve part 1 on the double sheet of journal paper, using page 1 for the general journal, upper half of pages 2 and 3 for the cash book, lower half of page 2 for the purchase book, and lower half of page 3 for the sales book, and page 4 for the business papers.

July 1, 1918: Student began the wholesale grocery business at 746 High Street, Columbus, Ohio, with the following assets and liabilities: Cash, \$2,500; stock of merchandise, \$14,000; furniture and fixtures valued at \$2,000; 60-day note for \$500 with interest at 6 per cent signed by R. L. Long and dated June 1, 1918. The following owe on account: C. F. Dunn, \$150; and Nixon & Co., \$200. Student owes the Interstate Grocery Co. on account \$1,200.

July 2: Paid White & Co. by check \$200 for one month's rent of premises.

July 3: Bought from Russel & Co., 2/10, n/30, invoice of merchandise (purchase No. 1), \$1,000.

July 3: Sold to Nixon & Co. for their 30-day note, bill of merchandise (sale No. 1), \$560.

July 5: Student withdrew cash for personal use, \$150.

July 8: Cash sales (sale No. 2), \$970.

July 13: Paid Russel & Co. by check for invoice No. 1, less 2 per cent.

July 15: C. F. Dunn sent you check for \$100 to apply on account.

July 16: Paid by check for an auto truck for draying merchandise, \$1,000.

July 17: Sold to King & Cohen one-half cash one-half on account 2/10, n/30, bill of merchandise (sale No. 3), \$1,940.

July 22: Gave Interstate Grocery Co. your check for \$200 and your 30-day note with interest at 6 per cent for \$1,000.

July 25: Paid cash for bill of office stationery and supplies, \$70.

July 26: Bought from Clark, Jewell & Co., 2/10, n/30, invoice of merchandise (purchase No. 2), \$1,200.

July 27: Received check from King & Cohen for one-half of sale No. 3 (July 17), less 2 per cent.

July 28: Returned to Clark, Jewell & Co. from purchaser of the 27th goods which were inferior in quality, \$150.

July 29: Cash sales (sale No. 4), \$380.

July 30: Paid clerks' salaries in cash, \$250.

July 31: R. L. Long sent you check for his 60-day note due to-day and the accumulated interest on same. (See opening entry.)

July 31: Sold an old office desk for \$40 in cash.

(a) Enter all the foregoing transactions in the books of original entry. (30 per cent.)

(b) Summarize, that is, prepare for posting the sales book, purchase book, and cash book, and balance the cash book. (10 per cent.)

(c) 1. Write the R. L. Long note from data in the opening entry. (5 per cent.)

2. Write a receipt for the transaction dated July 2. (5 per cent.)

3. Write the check for the transaction dated July 13. Your money is deposited in the Union National Bank, Columbus, Ohio. (5 per cent.)

PART 2 OF EXAMINATION

NOTE.—Solve part 2 (a) and (b) on the single sheet of journal paper and (c) on the single sheet of ledger paper.

Henry Wilson—Trial Balance, May 31, 1918

Henry Wilson, capital.....		\$9,000
Henry Wilson, private.....	\$300	
Cash.....	4,720	
Merchandise inventory, May 31, 1917.....	8,000	
Merchandise purchases.....	33,000	
Merchandise sales.....		43,000
Returned sales and allowances.....	850	

Furniture and fixtures.....	\$1, 500	
Delivery equipment.....	2, 000	
Expense.....	470	
Discount on sales.....	580	
Discount on purchases.....		\$490
Notes receivable.....	1, 600	
Notes payable.....		2, 100
Interest earned.....		160
Interest paid.....	210	
Rent.....	1, 800	
Stokes & Co.....		840
D. H. Hudson.....	370	
George Winn.....	1, 290	
E. D. Lewis.....		1, 100
	56, 690	56, 690

Inventories May 31, 1918

Merchandise.....		\$7, 000
Expense items unconsumed.....		120
Depreciation as under:		
Furniture and fixtures.....	per cent..	10
Delivery equipment.....	do.....	12½
Wilson owes \$200 for one month's rent.		

From the trial balance and other information:

- (a) Prepare a balance sheet. (15 per cent.)
- (b) Prepare a profit and loss statement. (15 per cent.)
- (c) Enter on the ledger sheet only the accounts that will be affected by the closing of the fiscal period and close the ledger as of May 31, 1918. (15 per cent.) (End of examination.)

Rehabilitation monograph. Joint Series No. 50.

Unit Course—Drafting 2—Mechanical Drawing II—Machine Details

DRAFTING

February, 1919—Trial edition

PART 1. DIRECTIONS TO INSTRUCTORS

1. QUALIFICATIONS OF STUDENT

This course is planned for the student who has had experience in mechanical drawing equivalent to the preceding unit course of this series, Drafting 1—Elementary Course in Machine Drawing.

2. AIMS OF THE COURSE

Upon completion of this course the student should be able to do the following:

- (1) Draw separately the parts of a simple machine from an assembly drawing.
- (2) Make an assembly drawing of a simple machine, having given the drawings for the parts.
- (3) Prepare part lists of simple machines, giving in tabular form certain necessary data for the production of the machine.
- (4) Indicate on the drawing for simple machine parts in conventional form the necessary instruction for machining these parts, such as drilling, reaming, facing and specifications for various kinds of screw threads.

3. LENGTH OF THE COURSE

This course, including a full set of details as assembly drawing and a part list, should be completed in 24 hours.

4. EQUIPMENT AND MATERIALS

The equipment specified in the preceding course on elementary machine drawing is sufficient for the detailing in this course. For the assembly drawing there should be provided a board 24" x 32", a 30" T-square, and a supply of drawing paper in sheets 22 x 31, or in a roll of either of these dimensions in width.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating mechanical drawing are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in commercial practice should be rated *poor*.

Out of justice to the student, his rating should be more than mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

(a) *Time*.—Is the student rapid, moderate, or slow in executing his work?

(b) *Technique*.—Does the student use workmanlike methods?

Does he exercise reasonable economy in use of materials?

Is he neat and orderly in care of tools?

(2) Finished product:

(a) *Accuracy*.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.

(b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.

(c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

(a) *Attitude toward work*.—Does the student love his work, or does he watch the clock?

Is he likely to continue in this line of work?

(b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work?

Does he express a desire to take advanced unit courses in this or related subjects?

(c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

(4) *Test problem.*—A test problem might be given at the conclusion of the course, which would involve all or most of the points covered by the course. The following questions are suggestive for such a test:

1. What is the meaning of a note such as the following: " $\frac{1}{2}$ x 13 U.S.S."?
2. When should a hole require reaming, when drilling?
3. Why are face marks placed on a drawing?
4. Where are face marks placed?
5. How should the end of a machine screw be rounded?
6. What is meant by the term "chamfer"?
7. Where is the $1\frac{1}{2}$ " measurement made if the note on the drawing calls for a $1\frac{1}{2}$ " hex?

6. OUTLINE OF LESSONS

This course includes the drawing of complete details from the assembly drawing of a set of bench centers, to be followed by the drawing of the assembly from the student's details. A part list will be included. It is suggested that the student draw the parts in the following order, taking the simpler and more elementary problems first:

- | | |
|-----------------------------------------------|-------------------------------------------------|
| 1. Stud. No. 3516. | 10. Set screw. No. 3513. |
| 2. Nut. No. 3518. | 11. Sleeve. No. 3507. |
| 3. No. 8 round-head machine screw. No. 3512. | 12. Center. No. 3506. |
| 4. No. 14 round-head machine screw. No. 3515. | 13. Sleeve in movable center casting. No. 3514. |
| 5. Stationary post. No. 3510. | 14. Sliding rest. No. 3503. |
| 6. Movable post. No. 3511. | 15. Indicator holder. No. 3505. |
| 7. Flange bushing. No. 3508. | 16. End bracket. No. 3504. |
| 8. Spring. No. 3509. | 17. Stationary center casting. No. 3501. |
| 9. Shaft. No. 3517. | 18. Movable center casting. No. 3502. |

7. SUGGESTIONS FOR TEACHING

There are three ways in which the work may be presented:

1. The completed assembly may be given the student together with the special instructions for each detail. When the set of details is drawn the assembly is taken away and the required assembly drawing made from the set of details.
2. The details may be completed from the partially complete perspectives and special instruction sheets, and the assembly made by referring to a picture of the machine or a small-sized photostat print of the assembly drawing.
3. The complete set of details given the student by the aid of which he completes the assembly and then works up the set of details from his own assembly, the specimen details having been taken from him.

The latter method requires considerable familiarity with machine parts, and should be followed only by the student who has had considerable shop experience.

The part list on page — follows the general practice of giving the required castings first. This order should not be followed when detailing; the more elementary problems should be completed first. The best order to follow is given in the outline of lessons above.

It should be understood by the instructor that the perspectives are not complete, but are supplemented by the special instruction sheets. Dimensions given on the perspectives are not the dimensions in all cases which should appear on the detail. This is true for two reasons, principally because the student is expected to apply the instruction given regarding the placement of dimensions, etc., and second, because it is not always possible to put the dimensions on a perspective which should appear on the detail.

The complete detail drawings, including part list, given herewith, on pages —, are for the instructor's use as a standard in examining and rating the student's sheets. They should not be given to the student to copy.

8. REFERENCES USED IN THIS TEXT

Principles of Machine Work, by Robert H. Smith. Published by the Industrial Educational Book Co., Boston, Mass.

Machinery Hand Book. Published by the Industrial Press, New York City.

Chart by American Screw Co. of Providence, R. I., on standard machine screws.

Chart by Machinery Industrial Press, New York, on standard bolts and nuts.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets, comprising Part 2 of this course, are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

GENERAL INSTRUCTIONS TO STUDENTS

Selection of scale and size of sheet.—When an object is to be detailed, the number of views required should be determined, then the selection of the views follows. The next step is to choose the size of standard sheet to use. A standard detailed sheet should be used when possible; this is to be the (A) size sheet. All drawings are to be made full size if possible. If it is impossible to place the views full size on an (A) sheet, the scale drawing is resorted to. The standard scales to use are full size, three-quarter size, half size, and quarter size. The words denoting the scale should be spelled out in the title space to avoid any possible misunderstanding. If the detail will not fit on the (A) sheet, three-quarter size, try half size. Possibly it can be drawn half size, but some small parts of the object will not be clearly shown or easily dimensioned; in such cases the (B) sheet is resorted to with the same procedure. If the (B) sheet does not fulfill the requirements, the (C) sheet is tried, etc.

The assembly should be drawn full size.

The name of the machine is placed on the first line in each title space. Under the drawing preferably, the name of the part should be placed on one line, the number of pieces required for one completed machine and the material from which the pieces are made on the second line, and if a casting, the pattern number on the third line, thus:

Indicator holder,
1-Req'd.-C. I.,
Pattern No. 3503

Finished marks indicate to the pattern maker that material is to be added to that required by the outline of the drawing. To the machinist the finished marks show where the machining operations are to be performed. They are placed on the lines indicating the faces which require finish. These faces are in general (1) those which have other faces of parts touching them, which facilitate the operating of the machinery; (2) the faces of bosses which adds to the appearance of the machine. (3) For special reasons the following are also finished: The rims of pulleys and gears, the parts which are handled, such as the rim of handwheels, handles, spokes of steering wheels, etc.

All threads are to be represented by four parallel lines only, two along the outside diameter and two along the root diameter. No attempt should be made in this course to show the profile of the thread. Diameter of roots of threads are to be found by reference to a table on thread sizes. If the thread is cut on a bolt, machine screw, etc., the outside lines are to be full lines and the root lines broken, or so-called dotted lines. If the thread is in a tapped hole, the four lines are broken lines.

One view is to be made of such parts as shafts, machine screws, etc., where it is readily evident that the part is cylindrical, a capital "D" being placed after the dimension for the diameter.

All notes are to be in letters one-eighth inch high where capital letters are used and two-thirds this height for lower-case letters. Figures are always the same height as the capitals.

The drawing number is to be placed above the title space.

The type sheet submitted illustrates the above points.

Order of work.—All points taken up in the Unit Course Drafting 1 apply to the detailing in this course. This is to cover such items as the determining of the number of views required, the selection of views, and the proper location of views on the sheet. The following steps should be followed in drawing the problems:

1. The locating of center lines.
2. The drawing of circles.
3. The transferring and projecting.
4. After the drawing is completed, following the above, the dimensions should be placed on the drawing, then notes added, and next section lines, if any are required.
5. Then the title space should be lettered and the drawing checked by the instructor.
6. After the drawing *with light lines* is approved, the full lines of the drawing and margin lines are intensified.

In general shop practice no drawing would be required of standard parts such as the nut and machine screws, as these parts would be taken from stock. Occasionally a drawing of these parts might be called for, however, and therefore a drawing of above-named parts is required in this course.

Notes calling for tap and reamer sizes, etc., should be placed above all details and arrow-heads point to that part which is threaded or reamed.

Sheet 1. The stud—No. 3516

References: For information regarding studs in general, their application, setting, etc., see Principles of Machine Work, by Smith, pages 283–284.



FIG. 1.

as " $\frac{1}{2}$ x13 U. S. S." The $\frac{1}{2}$ indicates the diameter in inches, the 13 indicates that there are 13 threads per inch of length of threaded portion, and U. S. S. means that the United States Standard form of thread is to be used.

All pieces turned between centers in a lathe, or held by a chuck in a lathe or screw machine, should be drawn with the axis in a horizontal position. This aids the mechanic in applying the dimensions called for by the drawing to the object as it is held by the machine.

See Principles of Machine Work, by Smith, page 190, Figure 251, showing operation of rounding the end of stock.

Make drawing full size on an A sheet, giving all dimensions shown in Figure 1. Only one view will be required. Why?

Sheet 2. $\frac{1}{2}$ " nut—No. 3518

References: See Principles of Machine Work, by Smith, pages 121–124, 285.

See table from Machinery for Standard Sizes of Nuts and Bolts.

A $\frac{7}{8}$ hex. always means the distance measured "across flats" of a hexagon. This is the distance measured from one side through the center of the hex. to the opposite side. To draw a hex., first construct a circle, the diameter of which equals the size of the required hex. Then circumscribe the hex. tangent to the circle. In the rectangular view always show the distance across corners as one of the dimensions.

The angle of chamfer is 45 degrees.

NOTE.—In the circular view the root circle is a full line and the circle representing the outside thread circle is a broken line. Why?

Dimensions should give amount of chamfer (this distance to be measured parallel with the axis), the thickness of nut, distance across flats, and distance across corners (in decimals). Size of thread should be given by a note, thus: Tap $\frac{1}{2}$ x13 U. S. S.

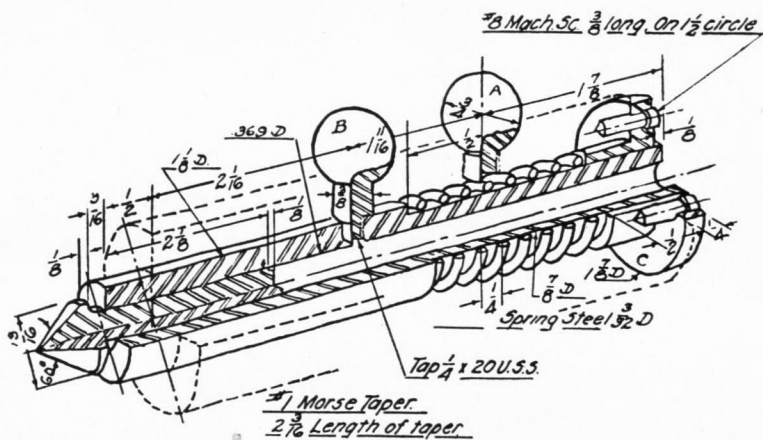
Draw two views, full size, on an A sheet.

Sheet 3. No. 8 Round-head machine screws—No. 3512

Sheet 4. No. 14 Round-head machine screws—No. 3515

References: Read Principles of Machine Work, by Smith, pages 291-300. Table from Machinery Hand Book, page 768.

Diameter of screws smaller than $\frac{1}{4}$ " are given in number size. These numbers refer to the wire gauge sizes. There are a number of different pitch threads in the different gauge sizes. For example, a No. 10 screw may have a 24-30 or 32 threads per inch. As far as possible, the standards given by the American Screw Co. should be used, as these are carried in stock by them and may be had immediately. The other sizes are special. Therefore, a No. 10x24 should be used.



But one view is required.

Draw *double* size on an A sheet.

Length dimensions are divided into four classes: Over all, shoulder turning, thread length, and those giving length of rounded ends.

See Principles of Machine Work, by Smith, page 190, Figure 251, showing the operation of rounding the end of stock.

Both diameters are to be given in decimals.

Sheet 5. Stationary post—No. 3510

This part is shown at A, Figure 2. Also shown separately as Figure 3.

A perfect thread can not be cut up to a shoulder. If it is required to have the piece fit another so that the shoulder will come up to the surface of the piece it fits into, one of two methods may be used to avoid bringing the imperfect thread in contact with the perfect thread of the tapped hole. First, the perfect thread of the tapped hole may be removed by recessing, as is done in the face plate of any lathe which threads on the spindle. Second, the imperfect thread may be cut away by necking the piece as is to be done here. The width of the neck in general drawing practice is equal to one pitch, and the diameter equal to the root diameter of the thread.

How many views are required?

Draw full size on an A sheet.

Sheet 6. Movable post—No. 33511

This part is shown at "B" in Figure 2.

Draw full size on an A sheet.

Sheet 7. Flange bushing—No. 3508

References: Principles of Machine Work, by Smith, pages 299–303.

This part is shown at "C" in Figure 2.

Draw full size on an A sheet.

Sheet 8. Spring—No. 3509

References: Principles of Machine Work, by Smith, pages 179–181.

As no information has as yet been given regarding pitch, the drawing of the spring is given (fig. 4). Only the application of dimensions, notes, etc., will be required of the student.

One view is sufficient.

Draw full size on an A sheet.

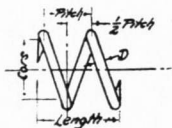


FIG. 4.

Sheet 9. Shaft—No. 3517

References: Principles of Machine Work, by Smith, pages 670–676.

The theory of limits is explained in the book to which reference is made.

In this work a limit of 0.0005 will be allowed for sliding fits and 0.0015 for driving fits.

One end of the shaft is ground to $1\frac{1}{8}$ " for a length of 2 inches.

A neck should be made in the $1\frac{1}{8}$ diameter to allow the grinding wheel clearance. This neck is to measure $\frac{1}{8}$ wide by 0.031 deep.

The shaft is to be ground all over, and the note on the drawing should call for this finish.

Make drawing full size on an A sheet, showing a break in the length in order to get it on the sheet.

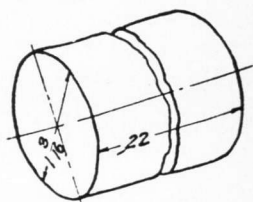


FIG. 5.

Sheet 10. Set screw—No. 3513

References: Principles of Machine Work, by Smith, pages 188–189.

Knurling lines to be about $\frac{1}{16}$ " apart and at an angle of 30 degrees to the axis.

Why is the end turned down as shown?

Draw full size on an A sheet.

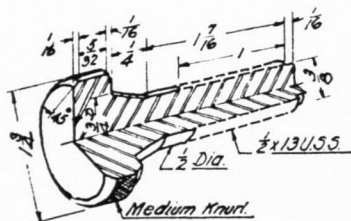


FIG. 6.

Sheet 11. Sleeve (stationary center casting)

References: Principles of Machine Work, pages 272–273.

The outside of the sleeve is ground to a diameter of $1\frac{1}{8}$ —0.0005.

The taper in the hole is a No. 1 Morse standard taper. See Machinery Handbook, page 1109, for sizes. It will be noticed that the tapered hole is longer than the hole required by the table. This hole will be made by a standard reamer, and the part of the hole extending beyond the end of the reamer will be straight. The diameter of this straight part is to be made by the nearest standard size drill which is larger than the small diameter of the standard No. 1 Morse taper.

Note on the taper should give the number of standard taper used and the amount of taper per foot. Diameter at larger end of taper to be given in thousandths.

Make drawing full size on an A sheet, giving all dimensions, as shown in Figure 7.

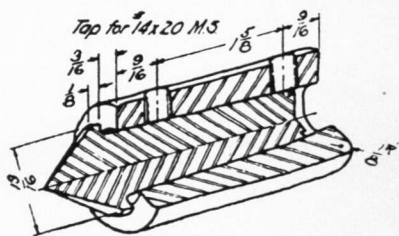


FIG. 7.

Sheet 12. Centers—No. 3506

References: Machinery Handbook, page 1108.

These parts are shown in Figure 2 and Figure 7.

The taper is a No. 1 Morse taper.

Rehabilitation monograph. Joint Series No. 51.

Unit Course—Drafting 3—Mechanical Drawing III—Thread work

DRAFTING

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENTS

This course is intended for the student who has successfully completed the previous unit course on Details and Assembly Drawing, or who can demonstrate to the satisfaction of his instructor that he has had an equivalent experience.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

Upon completion of this course the student should have a knowledge of the helix and its application to the United States standard square and acme forms of threads, and should be able to use conventional representations of these forms in machine drawing.

3. LENGTH OF COURSE

This course should be completed in 24 hours.

4. EQUIPMENT AND MATERIALS

The equipment used in the preceding courses will be sufficient for the work of this course.

5. STANDARDS FOR MEASURING AND RECORDING

The standards proposed for the preceding courses of this series will apply in this course also.

For a test at the close of the course, the following is suggested:

1. On a B sheet draw three rectangles, each representing a cylinder 3" diameter and 5" long.
2. On one cylinder draw a U. S. S. thread of $\frac{1}{2}$ " pitch.
3. On the second cylinder draw a square thread $\frac{3}{4}$ " pitch double cut.
4. On the third cylinder draw an acme thread $\frac{3}{4}$ " pitch.
5. Indicate visible edges only.

6. OUTLINE OF LESSONS

- | | |
|--------------------|-------------------------------------|
| (1) Helix. | (4) Acme thread. |
| (2) Thread. | (5) United States standard thread. |
| (3) Square thread. | (6) Bolt used as a fastening agent. |

7. SPECIAL SUGGESTIONS

The instructor should study carefully the suggestions given on student's instruction sheets, with the perspective of the object to be drawn.

8. REFERENCES

French, "Engineering Drawing," 1918 edition, \$2.50. McGraw Hill Book Co., 239 West Thirty-ninth Street, New York City, N. Y.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets comprising Part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2.—STUDENTS' INSTRUCTION SHEETS

GENERAL DIRECTIONS TO STUDENTS

All the principles taken up in the elementary course and the course in details and assembly apply to the work of this course.

Two objects will be detailed on each of the sheets and the general instruction regarding the spaces between views as given in preceding courses applies in this course. (Refer to the General Instructions of Unit Course on Elementary Drawing for Machinists.)

The following six steps applied to the construction of all threads will aid the student in avoiding errors in the location of the outline of the thread on both sides of the diameter of the stock upon which the thread is cut.

1. Lay off the pitch on *one* side of the diameter. Carefully lay down the dividers, taking care not to disturb the setting.
2. Subdivide the first pitch into equal parts.
3. Project from this point to the opposite end of the diameter.
4. From this point lay off the pitch on the second side.
5. Make the outline of the thread on both sides.
6. Connect the points which should be connected.

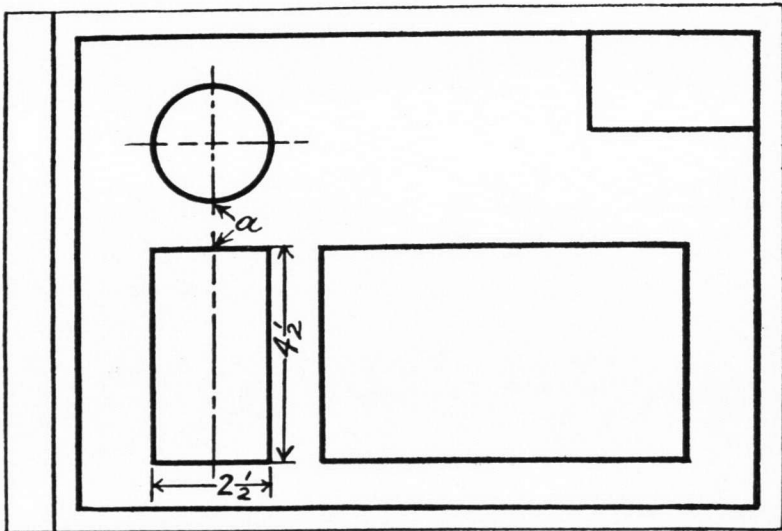


FIG. 1.

A *right-hand thread* is recognized by applying the following: If the axis of the cylinder is in a horizontal position, as is the case when the work is between centers in a lathe, and if the thread is cut on a bolt, machine screw, etc., the lines of the helix which can be seen should slant *down to the right*. If these lines slant *down to the left*, the thread is a *left-hand thread*.

All threads are to be *right hand* unless otherwise stated.

Careful workmanship is necessary on this work, as the measurements required are small and improper manipulation of the tools will in some cases destroy the particular point of the problem which should be demonstrated.

When the *tapped hole* is indicated by broken lines, draw four broken lines only; two along the outside diameter and two along the root diameter.

Sheet 1. The helix

References: French, *Engineering Drawing*, page 142.

Study the definition of the helix and the method of construction.

On an A sheet draw a cylinder, and the development of same, as shown in Figure 1.

The development of a curved surface is the laying out on a plane surface of a shape which when cut out properly bent or formed will make the surface which was to have been developed.

Figure 305, page 142 of Engineering Drawing, illustrates the method to be followed in dividing the given pitch into twelve equal parts.

The length of the developed surface may be found approximately by setting the dividers to the distance one-twelfth of the circumference found in the top view of the cylinder and stepping this distance twelve times along the horizontal line of the development.

Why is this an approximate method?

Use a $2\frac{1}{4}$ " pitch. Start the helix at point (a).

By first finding the location of the points on the developed surface projecting from the points on the front view of the cylinder, find the path of the helix by passing a line through these points.

Note that in traveling halfway around the cylinder the helix gets to a point which is located by dividing the pitch of the helix into two equal parts and projecting from this point to the opposite end of the diameter.

Note also that the broken line, indicating the line of the helix on the back of the cylinder, slants in the opposite direction from the slant of the full line. This shows that in a section drawing of a tapped hole the lines of the helix of a right-hand thread will slant down to the left when the axis is in a horizontal position.

The pitch of the helix is the distance, measured parallel with the axis, which the helix advances when it makes one complete turn around the cylinder.

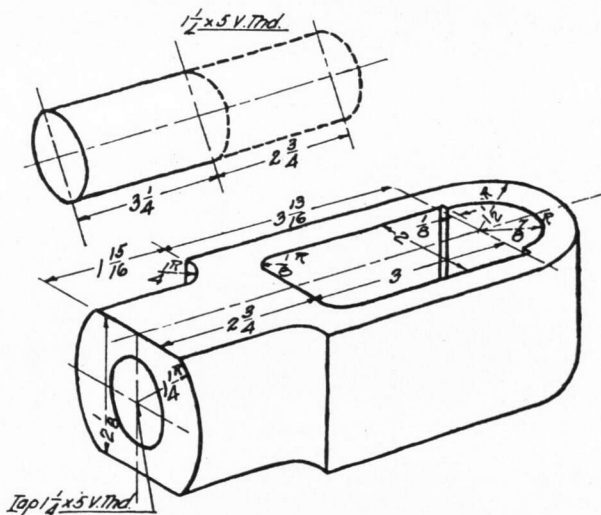


FIG. 2.

Sheet 2. Sharp "V" thread

References: French, Engineering Drawing, page 144. For proper outline the outline of the V thread.

On a B sheet make three views of the casting, top view as seen from position indicated by arrow A; side indicated by arrow B (fig. 2).

Front view in full section—no dotted lines in this view.

Make only one view of the arbor. Use conventional cross section on this drawing. Show full lines only.

Both pieces to be shown on the same sheet, the arbor above the casting. Place title in upper right corner of the sheet, using same spacing as in preceding unit courses.

NOTE.—Follow the six steps given in the general instructions when constructing the thread.

The thread should be drawn after all other full and broken lines of the drawing have been put in.

The true helix will not be drawn in any of the problems. The points on each side of the diameter are to be found and straight lines drawn to connect them.

Sheet 4. Acme thread

References: French, Engineering Drawing, page 141. For construction of the outline of the acme thread. This form is derived by first constructing a square thread and then drawing lines at 15 degrees to the vertical through points located half-way down the side of the square.

This thread to be a *double-cut* thread. See Engineering Drawing, page 143, for explanation.

Make three views of the nut "A" and one view of the stem "B" on a B sheet.

Side view of the nut to be in full section.

Sheet 5. United States standard

References: French, Engineering Drawing, page 141. For proper outline of thread.

This form is *not* to be derived as indicated by the construction shown by the cut (fig. 304 in Engineering Drawing), but as follows: First make the construction of the V thread, then change this form to that of the U. S. S.

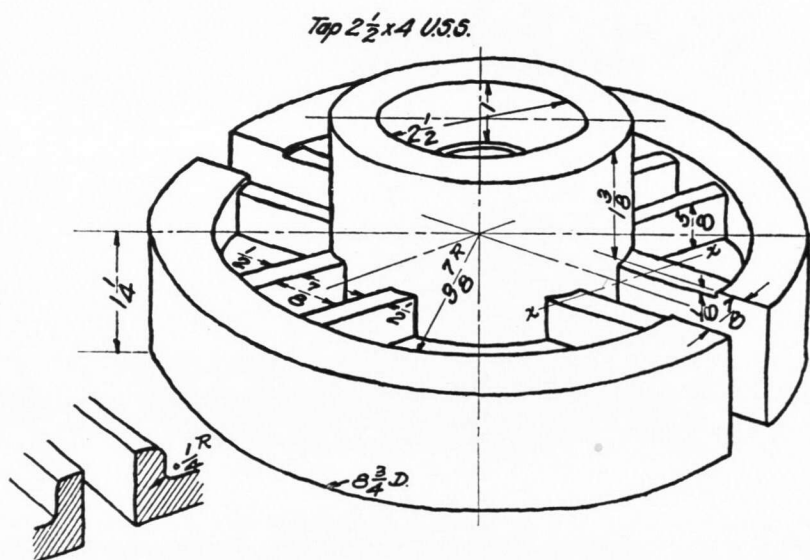


FIG. 6.

Make two views of the face plate (fig. 6), placing the circular view at the right, the other view to be in full section, with no dotted lines. On the circular view show a partial section as illustrated, cutting plane located at line x-x.

Line a-a is perpendicular in circular view.

Break part of the circular view for the title.

Sheet 6. Machine fastening

References: French, Engineering Drawing, page 160. Show the threads conventionally as in "A," Figure 310.

To draw the lines of the thread parallel use the T square and triangle as shown by Figure 35, page 24.

Draw front view as seen from position indicated by arrow (fig. 7). Make the right half of this view in section. Show no dotted lines in the entire drawing except those for the bearing, which is $1\frac{1}{2}$ " in diameter.

Show the bolt which fastens the cap to the base. This bolt has a square head, which is set into the base flush with the bottom face; leave $\frac{1}{16}$ " space all around the bolt head between it and the casting. Use a $\frac{5}{8}$ " standard bolt and hexagon nut. Drill $\frac{3}{16}$ " hole.

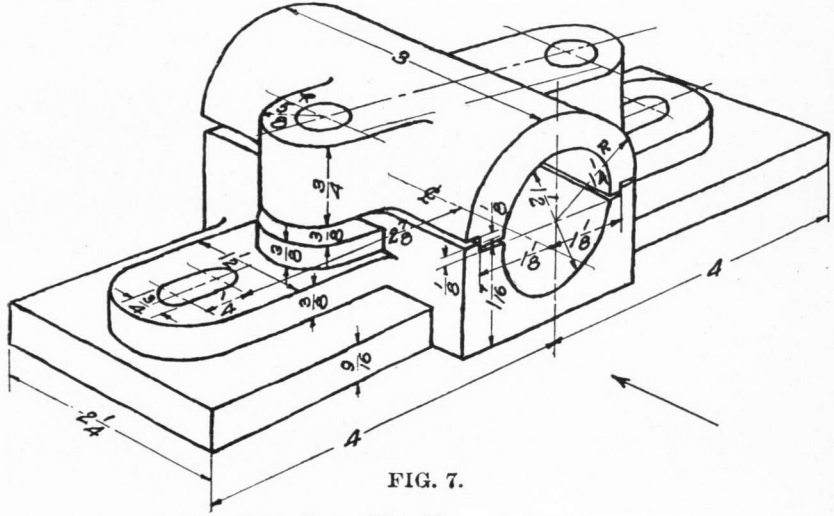


FIG. 7.

Rehabilitation monograph. Joint Series No. 52.

Unit Course—Painting and Decorating 3.—Treatment of old walls and ceilings

PAINTING AND DECORATING

February, 1919—Trial edition

PART 1. DIRECTIONS FOR INSTRUCTORS

1. QUALIFICATIONS OF STUDENTS

This course is intended for the student with some previous experience in the subject, at least equal to the two preceding courses in this series, namely, "painting new walls and ceilings," and "kalsomining and whitewashing."

2. AIMS OF THE COURSE

1. To improve men who are working at the trade and have had some experience in plain painting.
2. To enable the student to refinish old walls and ceilings according to the best modern usage.
3. To acquaint the student with the standard form or architect's specifications, and instruct in methods of estimating cost of work from specifications.

3. LENGTH OF THE COURSE

This course is planned to cover 30 hours of practical work by the student, distributed as follows:

	Hours
1. Washing off old kalsomine.....	1
2. Washing off old paint.....	1
3. Plastering and cutting old cracks.....	2
4. Making and filling holes with putty.....	2
5. Sandpapering and sizing.....	2
6. Mixing kalsomine and tinting.....	2
7. Applying kalsomine.....	3
8. Mixing paint and tinting.....	2
9. Applying first coat.....	1
10. Applying second coat.....	2
11. Applying third coat and stippling.....	3
12. Applying paint before enameling.....	1
13. Applying enamel.....	2
14. Removing paper.....	2
15. Washing walls for painting.....	2
16. Rigging of scaffolding, removing and cleaning pots, brushes, etc.....	2

4. EQUIPMENT AND MATERIALS

The lists of equipment and materials given for the preceding unit course in this series will be sufficient for the work of this course.

5. MEASURING, RATING AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit course issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating such subjects as painting and decorating are available, it is recommended that final rating be recorded as follows: The average student will be rated good, the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in commercial practice should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor, nor should this rating be influenced by personal feelings such as dislike or grudge. In order that the rating may be just, and of value both as a credential for the student and as a record for the school, the instructor should consider carefully the following factors in arriving at the rating:

Ability to carefully wash off ceiling and walls.

Ability to handle a sponge and brush with water, so as not to spatter.

Ability to sandpaper and prepare ceiling and walls of all descriptions.

Ability to paint in a thin even film.

Ability to putty holes between coats.

Ability to sandpaper walls between coats.

Ability to determine when wall is dry enough to apply the following coat.

Ability to handle brushes.

Ability to cut out cracks and plaster same.

Ability to touch up cracks with paint and shellac.

Ability to size ceiling and walls.

Personal care of hands and clothing.

Care of pots and material.

Care to be taken in measuring ingredients for painting.

Care of brushes.

Care and use of drop cloths.

Care of oil rags.

The instructor should also determine the value of each student according to interest and ability shown.

6. OUTLINE OF LESSONS

Problem 1. Reenamell a bathroom.

Problem 2. Old kalsomined ceiling to be prepared and painted three coats.

Problem 3. Old kitchen with painted walls covered with film of cooking grease, to be repainted two coats, gloss finish.

7. SUGGESTIONS FOR TEACHING

The instructor will observe the directions and suggestions given in the preceding courses.

The important new feature in this course is the study of architect's specifications and preparation of estimates for the cost of the work. The instructor should give particular attention to this feature. Show the student how to measure rooms and perform the computations necessary for estimating. Show him how to write out his estimate in correct form.

NOTE.—The students' instruction sheets which follow are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

1. This course includes a study of architects' specifications for the refinishing of three type rooms, and the practice necessary for performing the work according to these specifications.

The student should first study the specifications carefully. Remember that "contractor" in the specifications means you.

Before beginning each room, write out an estimate of the cost of materials and labor for the room. A form commonly used by contractors in submitting estimates is given following the specifications.

When the room is finished, make out a bill for the exact cost of time and materials, using the form given in unit course No. 2. Compare the bill with your estimate and explain the difference, if any, between the two.

ARCHITECTS' SPECIFICATIONS

The following is a form of specification generally given to contractors (painters, carpenters, etc.) by architects and builders:

PROPOSAL

The contractor shall carefully examine the specifications for the purpose of ascertaining if he has necessary details and information. Additional detailed information will be furnished on request.

The contractor shall visit the premises of the proposed work before submitting his proposal and satisfy himself as to the character and quality of the materials required. No allowances will be made after submission of proposals.

Workmanship.—The entire work is to be constructed and furnished in every part in a good, substantial, and workmanlike manner, according to the approved drawing and specifications, to the entire satisfaction of the owner. All necessary labor and material is to be provided for the complete and substantial execution of everything described, shown, or reasonably implied.

Materials.—All materials shall be the best of their respective kinds.

Guarantee.—The contractor shall lay out all work with diligence and expedition. He shall maintain and guarantee the stability of his work for a period of 1 year after completion of contract.

Protection of work.—The contractor shall take all necessary precautions for the protection of existing work, and any damage is to be made good at the expense of the contractor.

Completion.—At completion of the work the contractor shall promptly remove all tools and materials used by him during work and shall leave the job perfect in every respect.

Bathroom—Room No. 1

Ceiling and walls (now enameled).—To be prepared, painted 1 coat flat white and 1 coat gloss enamel, left in a gloss finish.

Library—Room No. 2

Ceiling.—To be washed off, cracks cut out, replastered, touched up with paint, then entire ceiling to be painted 3 coats, and stippled, light tan color.

Walls.—To have present paper removed, prepared and painted 4 coats, dark tan color, last coat to be stippled. Sample of color to be submitted to owner before last coat is applied.

Pantry and kitchen—Room No. 3

Ceiling and walls.—To be washed with washing soda, cracks to be filled with putty, entire painted 2 coats, gloss paint, carefully brushed.

The three rooms described in the architects' specifications above will constitute the three problems of this unit course. The work represented in these three rooms covers a large portion of the refinishing of old work which the student is likely to find in actual commercial practice.

ESTIMATE

Date_____

Name of owner_____

Work to be done at_____

I agree to furnish all necessary labor and materials to do the following work in a first-class workmanlike manner, using only the best materials of their respective kinds for the sum of \$_____

Bathroom—Room No. 1

Ceiling and walls (now enameled).—To be prepared, painted 1 coat flat white and 1 coat gloss enamel, left in a gloss finish.

Library—Room No. 2

Ceiling.—To be washed off, cracks cut out, replastered, touched up with paint, then entire ceiling to be painted 3 coats, and stippled, light tan color.

Walls.—To have present paper removed, prepared and painted 4 coats, dark tan color, last coat to be stippled. Sample of color to be submitted to owner before last coat is applied.

Pantry and kitchen—Room No. 3

Ceiling and walls.—To be washed with washing soda, cracks to be filled with putty, entire painted 2 coats, gloss paint, carefully brushed.

Respectfully submitted.

(Signature of contractor)

Accepted by:

(Signature of owner or agent)

DIRECTIONS FOR WORK ON ROOM NO. 1—BATHROOM

1. Write estimate of quantity and cost of materials needed for this room; also of time that will be required.
2. Wash off old surface now enameled with a weak solution of washing soda and clean water; then thoroughly wash with clear water or with a little vinegar added to water.
3. Thoroughly sandpaper old surface. Use No. 1½ grade.
4. Apply first coat of paint. This should be flat white in order that enamel may adhere well and not crack. Directions for applying this and the enamel are given in unit course No. 1.
5. Apply the enamel coat. This should be used carefully brushed.
6. Make out bill of actual cost for material and labor and compare with estimate made before beginning the work.

DIRECTIONS FOR WORK ON ROOM NO. 2—LIBRARY

1. Write estimate of cost of materials and labor for this room.
2. Wash off the kalsomine. Use hot water and sponges. Remove also as much as possible of the old sizing with washing soda and hot water or sandpaper. Where washing soda is used, vinegar should be used with water as an after wash, because if any soda is left it will eat through the paint.

3. Remove paper from the walls. Thoroughly soak the paper with a wet sponge until it will not absorb any more water.

It should then be carefully scraped off with a broad putty knife.

Walls should then be soaked with hot water and sponged off to remove any paste or glue that may remain.

4. Repair cracks in walls and ceiling. Cut out all cracks as wide and deep as necessary in a V or dovetail shape; wet well with clean water and refinish the cracks with two fillings of plaster of Paris or putty. When plaster is dry, sandpaper and give 1 coat of clear shellac.

5. Apply the various coats of paint to walls and ceiling. When wall surface has been prepared as directed above, the painting is done as explained in unit course No. 1.

6. Write bill for actual cost for materials and labor and compare with original estimate.

DIRECTIONS FOR WORK ON ROOM NO. 3—PANTRY AND KITCHEN

1. Make estimate for cost of materials and labor for this room.

2. Wash off ceiling and walls with washing soda and hot water. Use 1 pound of soda to a 14-quart pail of water.

Then wash with a solution of 1 quart of vinegar to 8 quarts of hot water.

3. Repair cracks in walls and ceiling. If the cracks are not bad they can be filled with putty. As a rule, puttying is done after the first coating, but where only 2 coats are given the puttying should be done first.

If the cracks are bad they should be treated as directed for room No. 2.

4. Apply the first coat of paint. This should be mixed with equal parts of turpentine and oil with about 1 per cent of dryer. Use 16 or 17 pounds of lead to the gallon for each coat.

5. Apply the second coat. This should be mixed with four parts of oil to one part of turpentine, with 1 per cent of dryer added.

6. Make out bill for actual cost of material and labor and compare it with original estimate.

Rehabilitation monograph. Joint Series No. 53.

Unit Course—Drafting 4—Architectural Drawing 1—Blue-Print Reading for Carpenters

DRAFTING

February, 1919—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF THE STUDENT

This course is intended for all workers who are interested in or have been connected with the building industry, such as carpenters, masons, architectural draftsmen, etc. No previous trade experience is necessary, but a common-school education is desirable.

2. THE AIMS OF THE COURSE

At the completion of this course the student should be able to read building plans of all descriptions. With a little more study and experience he could be fitted in a very short time to become an estimator or draftsman. This course is of particular advantage to those carpenters and masons who expect to become general contractors.

3. LENGTH OF THE COURSE

The average student should be able to finish this course in approximately 20 hours.

4. EQUIPMENT AND MATERIALS

1. Pencil.

2. One dozen sheets ruled paper, typewriter size.

3. One architectural scale.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating blue-print readings are available, it is recommended that final rating be recorded as follows: The student receiving a mark between 70 and 80 per cent will be rated fair; between 80 and 90 per cent, good; between 90 and 100 per cent, excellent. The student attaining an average per cent of less than 70 will be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) *Execution of work*

(a) Time: Is the student rapid, moderate, or slow in his work? (Caution: Never sacrifice accuracy for rapidity.)

(b) Technique: Is he neat and orderly in his work?

(2) *Finished problem*

(a) Accuracy: Should be determined by the record kept of errors in dimensioning, incorrect interpretations of conventions, etc.

(b) Mastery of principles: Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) *Interest*

(a) Attitude toward work: Does the student love his work, or does he watch the clock? Is he likely to continue in this line of work?

(b) Studiousness: Does the student show disposition to study the printed literature related to this work?

Does he express a desire to take advanced unit courses in this or related subjects?

(c) Possibilities of growth: Is the student likely in due time to receive promotion to positions of greater responsibility?

Test problem

A test problem should be given at the conclusion of the course which would involve all or most of the points covered by the course. A set of plans obtained from a local architect or from some governmental agency, may be used for this purpose.

6. OUTLINE OF LESSONS—TABLE OF CONTENTS

Lesson 1: The alphabet of architectural drawing.

Lesson 2: How different materials are shown.

Lesson 3: Dimensioning.

Lesson 4: How to use a scale.

(a) Architectural conventions.

- Lesson 5: Walls, partitions, windows.
- Lesson 6: Doors and other openings in walls.
- Lesson 7: Stairs.
- Lesson 8: Fireplaces.
- Lesson 9: Dining room and living room fixtures.
- Lesson 10: Kitchen and pantry fixtures.
- Lesson 11: Bathroom and bedroom fixtures.
- (b) Study of a complete set of plans.
- Lesson 12: First floor plan.
- Lesson 13: Cellar, second floor and roof plans.
- Lesson 14: Elevations and framing plans.
- (c) Supplementary lessons.

7. GENERAL SUGGESTIONS TO THE TEACHER FOR CONDUCTING THIS WORK

(1) These lessons have been so planned as to require a minimum of instruction on the part of the teacher. Every step has been explained. Every convention has been analyzed. Therefore, encourage the student to answer his own questions.

(2) Too much stress can not be laid upon the fact that a building plan is a set of conventions; that a convention is an established practice; and that practices vary in different parts of the country. The conventions here shown are used by the best architects throughout the country, and if the student understands these symbols he will have no difficulty interpreting any of their variations.

(3) The problems given at the end of each lesson are simply suggestions. As a lesson is finished, turn to your Supplementary Plans and base additional problems upon them.

(4) Review constantly.

(5) The numbers of the paragraphs given in "supplementary reading," which appears at the end of almost every lesson, refer to corresponding numbers in the book entitled "Architectural Drafting." The student will find a wealth of practical information in these references. They will also help to accentuate and fix in the mind of the student important points given in the lesson.

8. REFERENCE BOOKS FOR TEACHERS AND STUDENTS

Architectural Drafting, Greenberg & Howe. John Wiley & Sons, New York. \$1.50 per copy.

Building Age. A monthly magazine. The Architectural & Building Press (Inc.), 243 West Thirty-ninth Street, New York City. \$2 per year, or 25 cents a copy.

The American Carpenter. A monthly magazine. The Radford Architectural Co., Chicago, Ill. \$2 per year, or 25 cents a copy.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets, comprising part 2 of this course, are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

LESSON 1.—THE ALPHABET OF ARCHITECTURAL DRAWING

Give a Chinaman a sheet with the word "house" printed on it, and you might just as well give him a blank sheet. Ask a Frenchman to read the Chinese equivalent for the word house, and he will probably hold it upside down. But give a Frenchman, a Chinaman, and an American a painting or a drawing of a house, and it will be perfectly clear to all of them.

Drawing, therefore, is a universal language. And as every language has an alphabet, let us see what letters make up the language of drawing, or more particularly, architectural drawing which has to do with buildings, showing how they look and how they are constructed.

The full line is used to represent those parts or edges of an object which are visible. The dotted line is used to represent hidden edges or parts of an object.

To illustrate the use of these two lines, let us take a simple block with a hole in it, such as shown in Figure 1.

Is edge marked (1) equal in length to edge (2)? We can not tell from this drawing because the further an object is placed away from you the smaller it appears. Is edge (3) parallel to edge (4)? We can not tell, because our eye is so constructed that even parallel lines seem to meet way off in the distance. The next time you pass by a railroad station look at the car tracks as far as your eye can see, and you will find that at the furthest point the rails seem to meet. But in reality, of course, they do not meet.

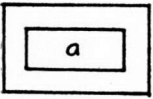
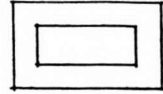
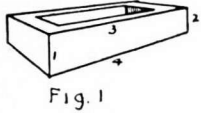
To obtain a true and accurate view of the top of the block shown in Figure 1 we must look down upon it in such a way that our eye is directly over every point of the object. If we do that we will get a view like the one shown in Figure 2, in which the true length of every line is seen and in which lines that are parallel to each other in the object are shown parallel in the drawing. Figure 2, because it represents the top of the object, is known as the top view or plan. The full lines represent the visible edges of the object.

The plan gives only the length and width of the block. How high is it? To answer this question we must look at the front of the object. We will then obtain (b), Figure 3. It is known as the front view or frontal elevation. Now look at the plan again. Does the hole extend through the object or only halfway? We can not tell. Nor can we see it if we look at the front of the object, Figure 1. We therefore represent the hole by dotted lines, as indicated. Examine Figure 3. Why is (c) called side elevation? Why are the dotted lines shown?

Of what material is the block shown in Figure 1 made? It may be of wood, steel, or other material. There is only one way to find out, and that is to cut through the object. Let us do that. Let us cut through the object with a saw marked 1, 2, 3, 4, Figure 4, and we will obtain the view shown at (b). An architect would indicate the saw by the line X-X, Figure 4 (c), and the view of the object after part of it has been cut away by the drawing (d). Figure 4 (d) is known as a section.

The reference line (— — — — —) shows or refers a person to the line along which the section is taken.

The section lines or crosshatching lines show the solid parts of the object cut through. These inclined lines, drawn at an angle of 45° , represent the markings of the saw on the material. These section lines simply indicate that the object has been cut, but they do not show the kind of material of which the object is made. There are different crosshatchings used to represent different materials, and what these crosshatchings are is the subject of our next lesson.



a-PLAN
b-FRONT ELEVATION
c-SIDE ELEVATION

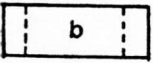
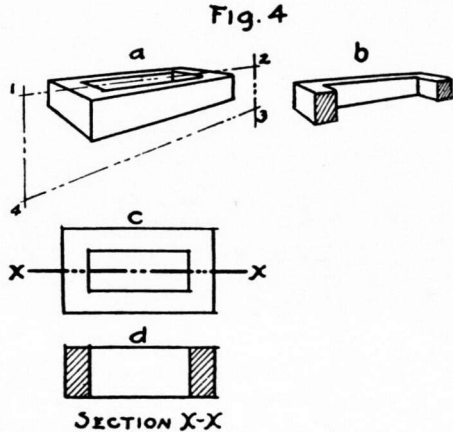
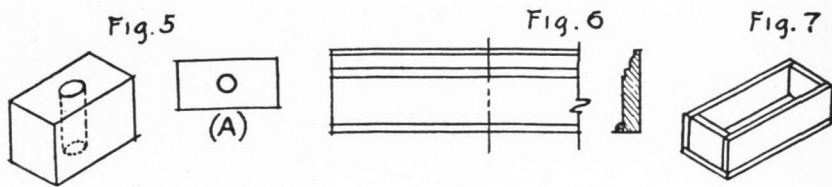


Fig. 3



Problems 1, 2, and 3

- 1. What view is shown at (A), Figure 5? Sketch the front elevation.
 - 2. Name the lines and views shown in Figure 6.
 - 3. Make a free-hand drawing showing three views of Figure 7. Name the views.
- Supplementary reading, paragraphs 17 to 21, inclusive.



LESSON 2.—ARCHITECTURAL CONVENTIONS

The alphabet of architectural drawing is a shorthand alphabet. And just as there are different systems of shorthand, so there are different methods of representing the same architectural detail. However, the sytem of symbols we shall use in this course has been accepted and is employed by the best architects.

The architectural alphabet is sometimes referred to as “architectural symbols,” but more often as “architectural conventions,” convention meaning a custom established by general practice.

HOW DIFFERENT MATERIALS ARE SHOWN

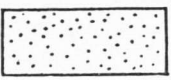
(a) Crosshatchings

Figure 8 shows one method of representing the most common building materials, the left-hand row giving the conventions used on plans and sections; the right-hand row, on elevations.

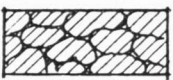
KEY TO MATERIALS		
SECTIONS		ELEVATIONS
	BRICK	
	CUT STONE	
	RUBBLE	
	CONCRETE	
	METAL	
	PLASTER	
	WOOD	

Fig. 8

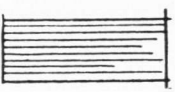
As stated before, these conventions are not arbitrary. For instance, a plaster section may be shown thus,



a rubble section thus,



a brick elevation thus,



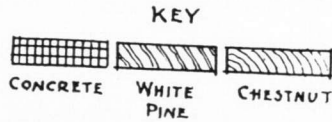
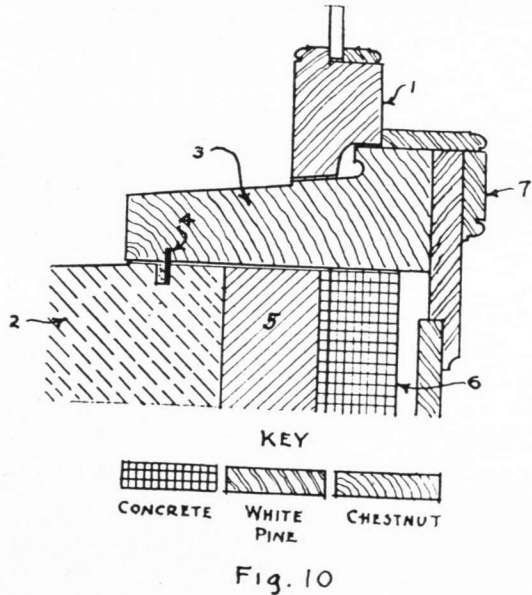
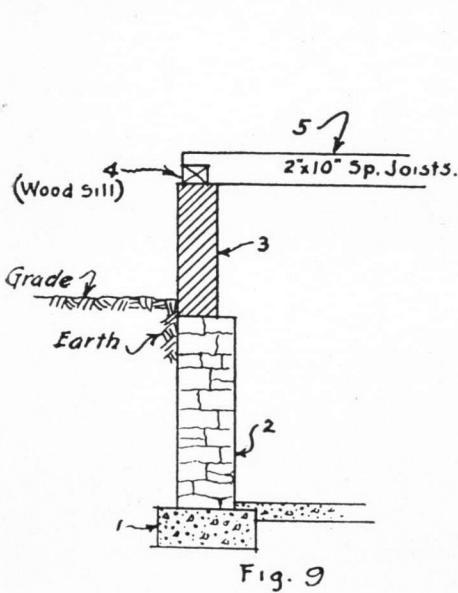
For that reason, a small rectangle, similar to the one shown in Figure 8, with the legend “key to materials” printed at the top, is very often placed on one of the drawings. If no such key is found, the indications of Figure 8 may be followed.

(B) Colors

Another method of representing building materials is by means of coorls, the following being those most commonly used:

- Red indicates brick.
- Yellow indicates wood.
- Blue indicates stone.
- Green indicates glass.
- Black indicates steel, iron or other metal.
- Blue or sepia with black dots indicates concrete.

Here also a "key" similar to the one used for crosshatchings should be employed.



(C) Abbreviations

- T. C. stands for terra cotta.
- Y. P. stands for yellow pine.
- L. L. Y. P. stands for long leaf yellow pine.
- N. C. Pine stands for North Carolina pine.
- Sp. stands for spruce.
- C. I. stands for cast iron. Etc.

The abbreviations used are too numerous to mention. As carpenters you will have no difficulty recognizing the abbreviations for different kinds of woods. Abbreviations for other materials are self-evident. Those that need explanation will be taken up when we come to them in the course of our study.

Problems 4 and 5

4. Substitute the names for the numbers shown in Figure 9.
5. Do likewise with Figure 10 referring to the accompanying "key" for additional information.

Supplementary reading, paragraph 31.

LESSON 4.—HOW TO USE A SCALE

If you had a small object to draw you would draw it full size. That is to say, if you measured one edge of the object and found it to be 7", you would draw a line 7" long to represent it. If you had a larger object, you might draw it half size, that is, every inch on your drawing would represent 2" on the object. If you had still a larger object you might draw it one-quarter size, one-eighth size, etc. To so reduce all the measurements of an object that it may be represented conveniently on a drawing sheet is known as drawing that object to scale.

The scale of an object is always calculated on the basis of a foot. Thus, if a scale is full size it would be indicated this way: 12"=12", or 12"=1'-0" and not 1"=1". If the scale is half size it would be written in this manner: 6"=1'-0"; one-quarter size, 3"=1'-0", etc.

Scale $\frac{3}{4}"=1'-0"$ means that every inch on your drawing represents one foot on the object. What do these scales mean? $\frac{1}{4}"=1'-0"$; $\frac{1}{8}"=1'-0"$; $1\frac{1}{2}"=1'-0"$.

Almost all architectural drawings are laid out to a scale of $\frac{1}{4}"=1'-0"$. If the building is very large, the scale used is $\frac{1}{8}"=1'-0"$. The details of a house are usually drawn F. S. (full size), $1\frac{1}{2}"=1'-0"$ or $\frac{3}{4}"=1'-0"$.

Now, take up your scale and examine it. To the extreme left or to the extreme right of one face of your scale you will find the fraction $\frac{1}{8}$; at the opposite end of the same face you will find the fraction $\frac{1}{4}$. Now locate the fraction $\frac{3}{8}$, and you will find $\frac{3}{4}$ at the other end. Continue your examination and you will observe that on the same face or edge the figure at one end is always twice the figure at the other end.

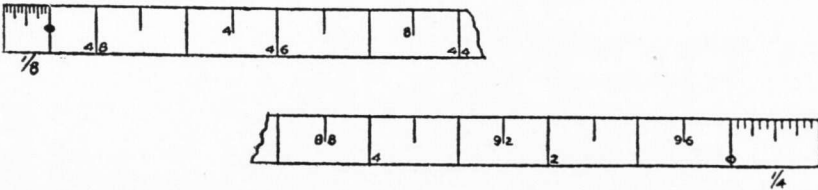


Fig. 13

Let us make a thorough study of one face, namely, that marked $\frac{1}{8}$ at one end and $\frac{1}{4}$ at the other. The observations we make and the conclusions we reach regarding this face or these two scales apply to all other faces and to all other scales. For purposes of illustration we will enlarge the divisions on the face above referred to. See Figure 13.

Notice that the one-eighth division is divided into 12 equal parts; therefore, if the scale is $\frac{1}{8}"=1'-0"$, each one of these parts represents 1 inch. Again, the one-quarter division is also divided into 12 equal parts; hence, if the scale is $\frac{1}{4}"=1'-0"$, each of these divisions indicates 1 inch.

Now go back to the one-eighth-inch scale. Each one of the divisions to the right of the line marked "0" represents one-eighth of an inch, or 1 foot if the scale is $\frac{1}{8}"=1'-0"$. Now count off four divisions to the right of "0" and you will find there the figure 4. Starting again from the zero division, count off eight divisions and you will find there the figure 8. All the figures, therefore, on the upper row on the same level with "0" represent one-eighth-inch divisions, or 1 foot, if the scale is $\frac{1}{8}"=1'-0"$. Using this scale, draw a line 3'-0" long; 24'-0"; 52'-0"; 96'-0".

To draw a line 4'-5" long, count four divisions to the right of "0" for feet and five divisions to the left of "0" for inches. Zero should always be the starting point, whether you want feet or inches, or both. Draw to a scale of $\frac{1}{8}"=1'-0"$ the following lines: 10'-2"; 15'-9".

Look again at the 12 parts into which the one-eighth-inch division is marked. If the scale is $\frac{1}{8}"=1'-0"$, note how easy it is to locate 3", 6", and 9". The space is too small to print these figures. But if you will turn to your three-fourth-inch scale or $1\frac{1}{2}$ -inch scale you will find those figures shown.

Suppose the scale is $\frac{1}{8}''=1''$ (that is, $1\frac{1}{2}''=1'-0''$). Therefore, each division to the right of zero on the one-eighth-inch division represents 1 inch, and each division to the left of zero represents one-twelfth of an inch. Draw a line to this scale $4\frac{1}{2}''$ long: $6\frac{3}{4}''$; $11\frac{1}{4}''$.

Similarly with the one-fourth-inch scale. Observe where the "0" is marked. All figures on the same level with that zero indicate one-fourth divisions. If the scale is $\frac{1}{4}''=1'-0''$, draw a line $2'-0''$ long; $15'-0''$. Now draw lines $17'-6''$ and $8'-3''$ in length. If the scale is $\frac{1}{4}''=1$ inch (or $3''=1'-0''$), draw a line $1\frac{1}{2}''$ long; $9\frac{3}{4}''$ long.

Be careful not to confound the figures. The upper row of figures represents one-eighth divisions and the lower row one-fourth divisions.

Important: Follow only written dimensions. If in practice you find that the width of a dining room, for example, scales $11'-6''$ but has the printed dimension of $10'-6''$, make that room $10'-6''$ wide. A blue print is prepared by soaking it in water; hence it shrinks when it dries. The following sentence is therefore inserted in every specification: "Where figures are given they are to be followed in preference to measurement by scale."

Sometimes the scale is represented graphically on a drawing. Instead of finding the scale expressed in this manner, $\frac{3}{4}''=1'-0''$, you may find it this way:



Observe how simple it is, by this method, to find the length of a line measuring $3'-4''$. These graphic scales are most often used on drawings of houses which are reproduced, without dimensions, to a very small size.

Problems 7, 8, and 9

7. Figure 14 is drawn to a scale of $\frac{1}{4}''=1'-0''$; fill in the dimensions.
8. Figure 15 is drawn to a scale of $1\frac{1}{2}''=1'-0''$; fill in the dimensions in the spaces provided.
9. To what scale is Figure 12 drawn?
Supplementary reading, paragraphs 6 and 7.

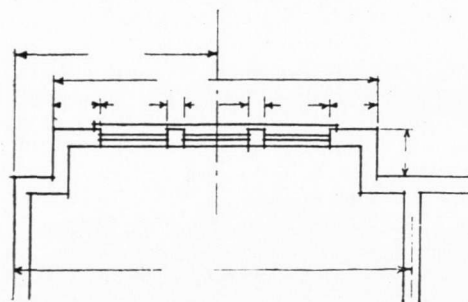


Fig. 14

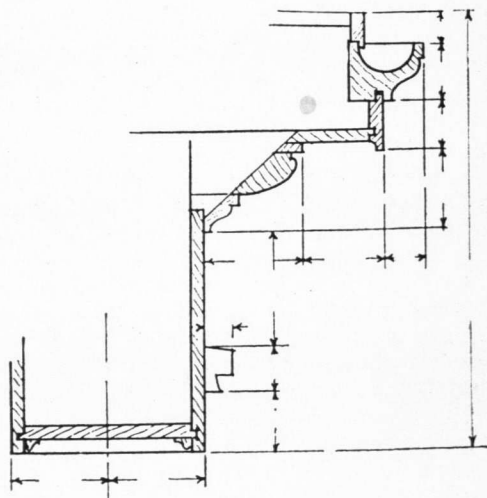


Fig. 15

LESSON 5.—WALL, PARTITION, AND WINDOW CONVENTIONS

The term "plans" is applied to any complete set of drawings for a house, and consists of the plans of all the floors, all the elevations, sections, and details; in short, all the drawings necessary to give the builder a clear understanding of the finished structure.

Now, let us return to the architectural alphabet, which, you will recall, we decided to name "architectural conventions," on floor plans and elevations.

Walls and partitions.—Two parallel lines shown on scale 6 inches apart indicate a frame wall or a frame partition. (See fig. 16.)

Two parallel lines shown 8 inches or more apart, depending upon the thickness of the wall, with 45° section lines between them, indicate a brick wall or partition. (See fig. 17. For representation of walls of other materials see lesson 2.)

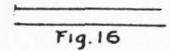


Fig. 16



Fig. 17

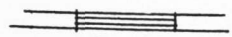


Fig. 18

Windows.—A double-hung window consists of two parts or sashes which slide up and down by means of cords and weights suspended from pulleys.

In a frame wall a double-hung window is indicated as shown in Figure 18, or as in Figure 19, in which (x) represents the sash and (y) the exterior sill. The

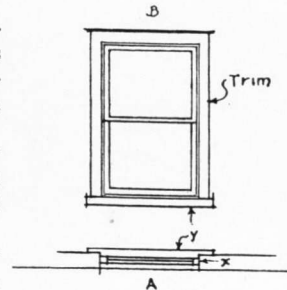


Fig. 19

conventional way of showing the elevation of a double-hung window is given at (B), Figure 19.

A double-hung window in a brick wall is indicated in practically the same. (See fig. 20.)

In this illustration (x) indicates the box in which the weights are housed; (y) the sash; and (z) the outside sill, extending about 1 inch beyond the face of the wall and about 2 inches on either side of the opening. The space (p) on the interior indicates plaster. The conventional way of showing the elevation of a double-hung window in a brick wall is the same as that shown for a frame wall, except, of course, that the outside wood trim is omitted.

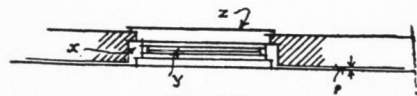


Fig. 20

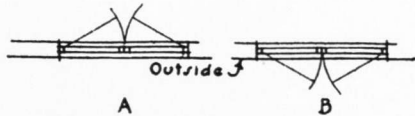


Fig. 21

A casement window also has two sashes, but these are divided vertically and are hinged at the sides, opening and closing like a door. A casement window which extends down to the floor is called a French window. Casements swing in, as shown in Figure 21 (A) or out, as shown in Figure 21 (B). In these illustrations the 30° lines represent the sashes or wings of the window, and the arcs show the direction of the swing.

An elevation of a casement window with a transom, in a brick wall, is shown in Figure 22.

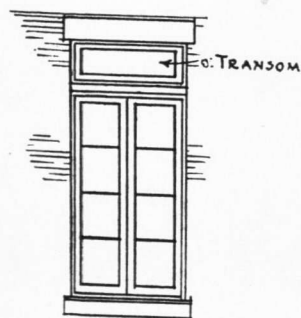


Fig. 22

Not infrequently two or three windows, double-hung, or casement, or both, are combined under one frame, as shown in Figure 14. When thus united the vertical divisions between the windows are called "mullions," and the combined window is known as a "mullion window."

A bay window is one which projects beyond the face of the wall. See Figure 14. It may be made up of double-hung windows, casement windows, or a combination of the two.

A dormer window is like a bay window except that it projects from a sloping roof instead of from a wall. (See fig. 23.)

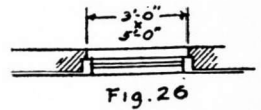
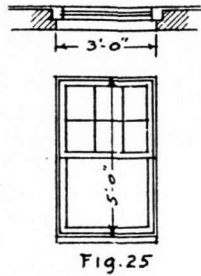
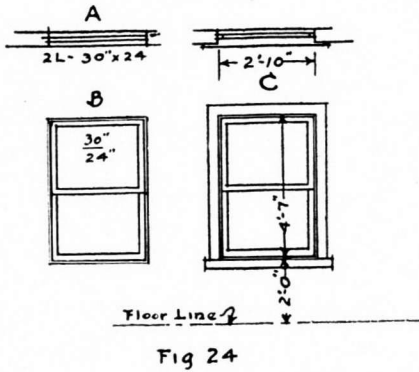
We shall close this lesson with a discussion of the different ways of indicating the size of a window.



Fig. 23

The width and height of windows appearing in frame walls are shown in one of the following ways: (1) On the plan as shown in Figure 24 (A), which translated means that the window consists of two lights, each 30 inches wide and 24 inches high, the width always being stated first. (2) On the elevation, as shown at (B). (3) On the plan and elevation as shown at (C).

The width of a window in a brick or other masonry wall is shown on the plan and the height on the elevation, as illustrated in Figure 25. Another method is to indicate both the width and the height on the plan. (See fig. 26.)



Problem 10. See Figure 27

- (a) What kind of window is shown at (A); at (B)?
- (b) How many mullions are there in the bay window?
- (c) Find the scale to which this plan is drawn and fill in the dimensions.

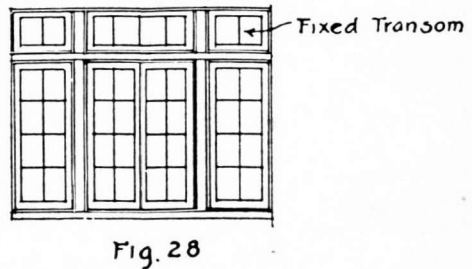
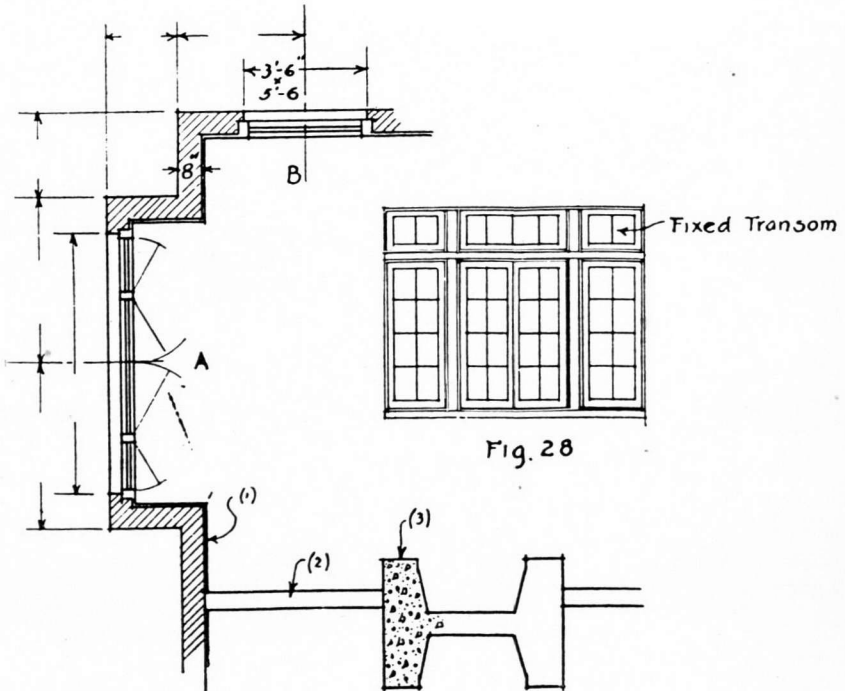


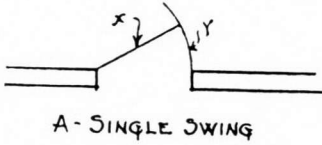
Fig.27

- (d) How thick is the exterior brick wall?
 - (e) What material is shown at (1), (2), (3)?
 - (f) How high is the double-hung window?
 - (g) What does Figure 28 represent?
- Supplementary reading, paragraphs 79 to 89, inclusive, also paragraph 105.

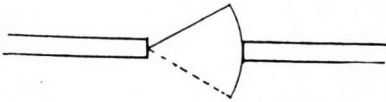
LESSON 6.—DOOR AND COLONNADE CONVENTIONS

Doors.—Figure 29 shows the manner of indicating different types of doors on a plan.

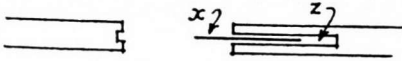
The 30° line, as at (x), Figure 29 (A) represents the door and the curve (y) its swing. Figure 29 (B) shows a door hinged at the center to swing in and out; (C) shows a single-sliding door, in which (x) represents the door and (z) the pocket for the door; (D) needs no explanation; (E) shows how to indicate the width, height, and thickness of a door in plan.



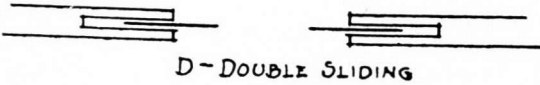
A - SINGLE SWING



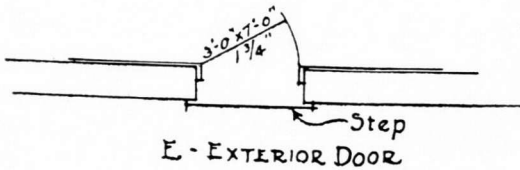
B - DOUBLE SWING



C - SINGLE SLIDING



D - DOUBLE SLIDING



E - EXTERIOR DOOR

Fig. 29

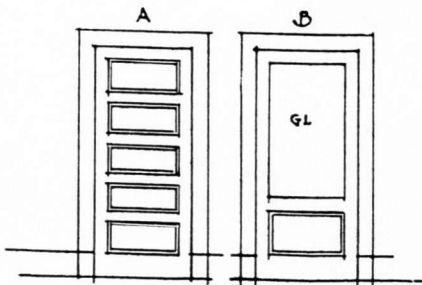


Fig. 30

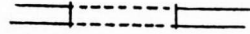


Fig. 31

There are innumerable designs for doors. In Figure 30 two varieties are shown. Note how wood panels are shown. In (B) observe how glass is indicated.

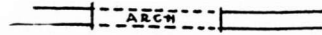


Fig. 32

Figure 31 represents an opening in a wall without a door and with a rectangular beam as a lintel. (Lintel means a beam of wood, stone, or other material placed on top of an opening to support the wall above.)

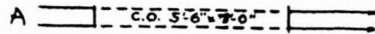
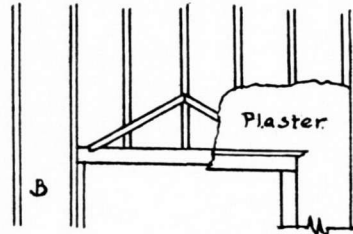


Fig. 33

Figure 32 represents an opening in a wall without a door and finished with an arch overhead.

Figure 33 (A) represents a cased opening 5'-6" wide and 7'-0" high. "Cased" is the name applied to the timber framing which surrounds an opening in a wall; (B) shows the usual method of framing a cased opening.

Colonnades

A cased opening with a square post at either end, forming what is called a "colonnade," is shown in Figure 34. One composed of a column resting on a pedestal is shown in

LESSON 7.—STAIR CONVENTIONS

In Figure 38 is shown the plan and elevation of a straight-run stairs. In Figure 39 you see a section through one step, drawn to an enlarged scale to show clearly its construction. Study these drawings carefully and memorize the names of all the parts of the step and of the stairs.

Your attention is especially directed to the plan. Note how each riser is numbered. The arrowhead at the foot of the stairs shows its direction, for you can not tell from a plan whether the stairs go up or down. "Up 16R" therefore means that these stairs go up and that there are 16 risers to the flight. How many treads are there? Always one less than the number of risers.

Two styles of stairs are shown in the elevation; at (A) is shown an open-string stairs and at (B) a closed-string stairs. Why are they thus called?

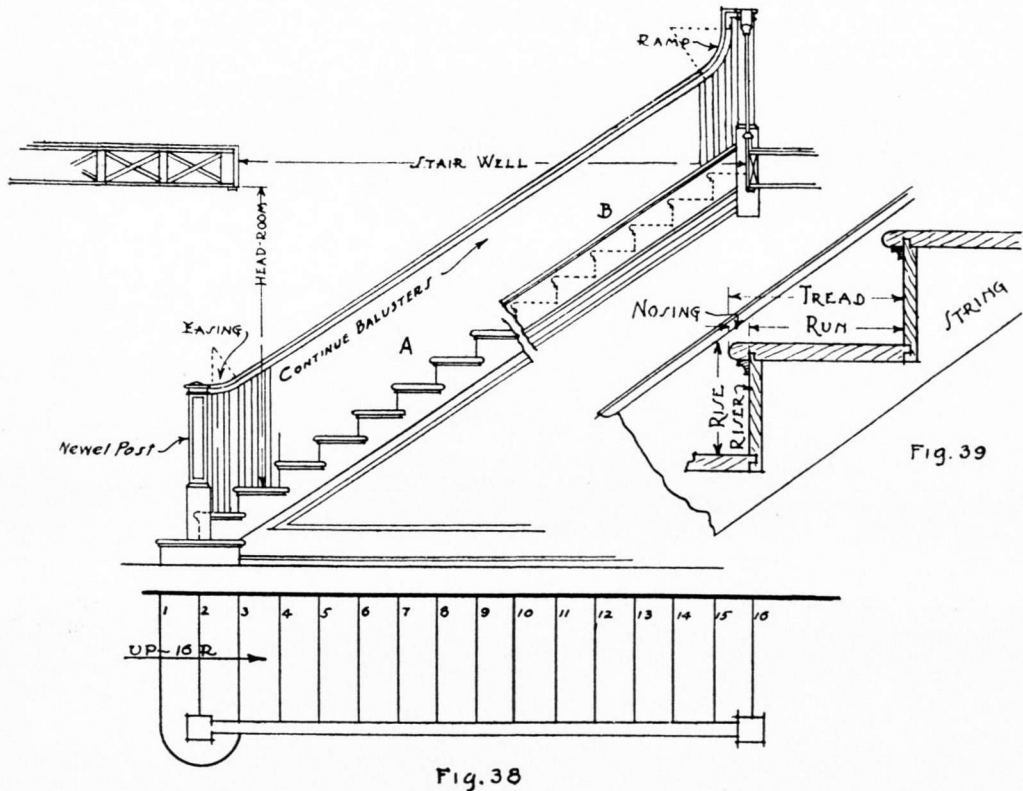


Fig. 38

Fig. 39

The stairs shown in Figure 40 (A) is known as box stairs, because it is inclosed between two walls.

Figure 40 (B) shows the plan of a flight of stairs with one turn. Note the newel post at the foot of the stairs, one at the angle, and one at the head of the stairs. The triangular steps on the turn are called "winders."

The plan of an open newel stairs is illustrated in Figure 40 (C). The blank space (x) is known as a platform or landing; the opening (y), as a well hole.

A common arrangement of stairs is shown at (A) and (B), Figure 41. The stairs marked "(A)" go up to the second floor, while those marked "(B)," which are directly underneath

(A), go down to the cellar. To represent these two sets of stairs on one plan it is necessary to cut out the upper part, marked "(x)," of stairway (A), so that when you look down you can see the first few steps of both sets of stairs (C). Figure 41 is a plan of the view thus obtained.

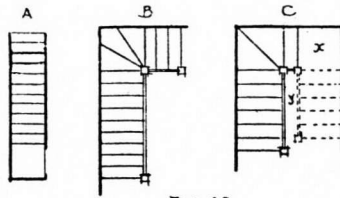


Fig. 40

If instead of stairs we had a closet under a flight of stairs, it would be represented in plan as shown in Figure 42.

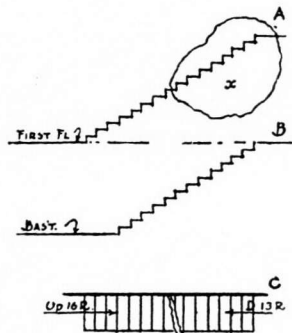


Fig. 41

In this drawing the broken line indicates where the upper part of the stairs has been removed to show what is underneath.



Fig. 42

Now examine Figure 43; to get to the second floor from the hall on the first floor you must climb up 15 risers. The first riser, you will notice, is carried completely around the

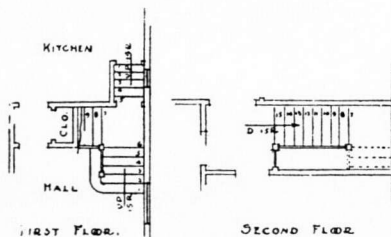


Fig. 43

stairway. When we reach the sixth riser we come to a platform. We then turn to the left and continue our ascent. About half way, riser 9, the stairs are broken off and we see a closet underneath. But where are the rest of the stairs? Look on the second floor plan and you will find them there. Now look at the stairs going up from the kitchen. The arrow says "Up 14R." After climbing up five risers we come to the same platform that required six risers to reach from the hall. What does that indicate? Simply that the kitchen stairs have higher risers than those leading up from the hallway.

Problem 12. See Figure 44

What elevation is shown at (A)? At (B)?

Locate step marked "(x)" on the plan.

Locate the newel post (y) on the plan.

Locate the cased opening on the plan; the door marked "(z)".

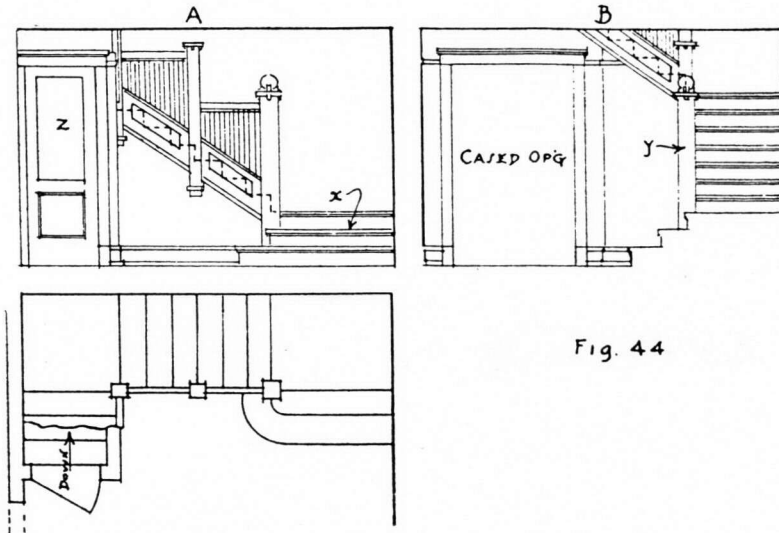


Fig. 44

Problem 13.—Analyze the stair arrangement shown in Figure 45

What does (x) represent?

Explain the meaning of the figures shown at (y) and (z).

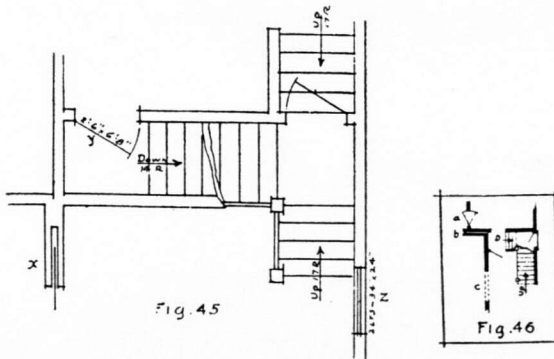


Fig. 45

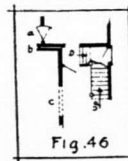


Fig. 46

Problem 14.—Explain the stair communication shown in Figure 46

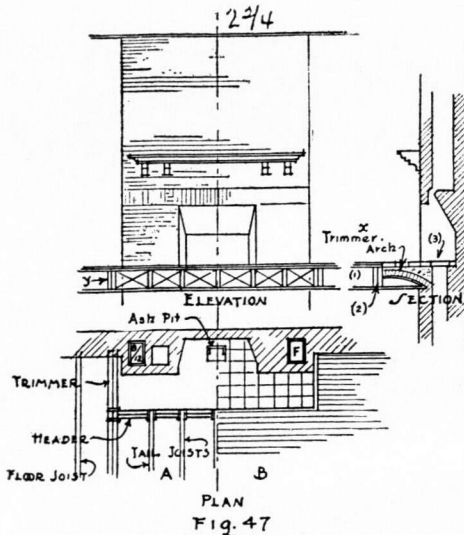
Translate the conventions shown at (a), (b), and (c).

Supplementary reading, paragraph 110.

LESSON 8.—CHIMNEY CONVENTIONS

In Figure 47 are shown the plan, elevation, and section of a fireplace.

Two views are given in the plan, one (A) showing the framing around the fireplace, and the other (B) showing its finished appearance.



Since the fire regulations require all wood-work to be kept away from a fireplace, it is necessary to cut away those floor beams which come directly in front of it. The ends of these cut-off beams are supported in the following manner: Two beams, called "headers," placed at least 18 inches away from the nearest point of the chimney, are set parallel with the chimney breast. The cut-off floor beams, called "tail joists" or "tail beams," are then connected to these headers either by means of bridle irons, one of many forms of which is shown at (A), Figure 48, or by means of a tusk and tenon joint, as shown at (B).

The headers, in turn, are supported by trimmers, which are also made up of two beams placed about 2 inches away from the chimney and set parallel with the floor beams. The headers are framed into the trimmers in the same manner just described for tail beams.

The space left in front of the fireplace. Figure 47, is filled in with concrete resting on a

trimmer arch, as shown at (x) in the section. The concrete is then finished off with a layer of cement and the brick or tile is set in place.

The rectangular holes in the brickwork of the plan are, of course, flues. The smaller rectangle inside the larger one of the flue marked "(F)" indicates the flue lining. The fraction $\frac{8}{12}$ signifies that the flue is 8 by 12 inches.

Now examine the elevation. The double beam (y) at either end of the chimney indicates the header. What do the single beams between these headers represent? The crosspieces between the floor joists indicate bridging. All joists should be bridged once in every 8 feet of their length, with 1 by 3 inch or 2 by 3 inch scantlings (small timbers) nailed crosswise between each pair of joists. Bridging stiffens the beams by preventing them from buckling sideways.

The single space, about 1 inch, underneath the joists in the elevation indicates plaster. The double space, each about 1 inch, above the joists indicate two thicknesses of flooring—the under or rough floor laid diagonally over the joists, and the finished floor, laid over the rough floor and at right angles to the joists.

The student should now be able to explain the framework around the chimney as shown in the sectional view. What do (1), (2), and (3) represent?

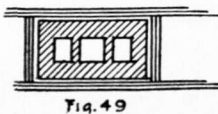


Fig. 49

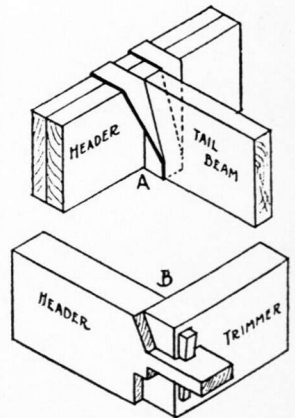


Fig 48

Problem 15

Figure 49 represents the framing around a chimney on a roof. (a) Name the framing timbers. (b) Mark the size of the center flue, the scale of this drawing being $\frac{1}{4}'' = 1'-0''$.

Problem 16

In Figure 50 is shown a double fire place. (a) In place of the figures substitute the names of the various members. (b) What is the space marked (x) reserved for? (c) Explain the meaning of the double lines and of the fraction in the flue marked (y).

Supplementary reading, paragraphs 85, 91, and 92.

LESSON 9.—DINING-ROOM CONVENTIONS

A plan is really a horizontal section through a building. It is a view obtained when you look down upon a building after it has been cut off, so to speak, horizontally somewhere about half way between the floor and the ceiling.

It stands to reason, therefore, that dotted lines on a floor plan represent either parts under the floor or over the imaginary section line on the ceiling.

Figure 51(A) is the plan of a dining room. What do the dotted lines represent? They may represent something underneath the floor or something on the ceiling. They can not

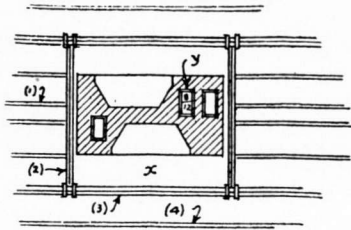
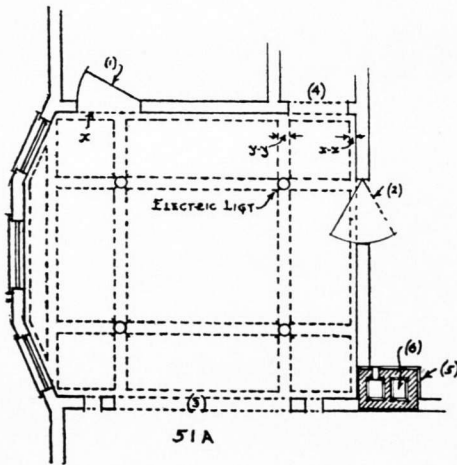


Fig. 50



51A

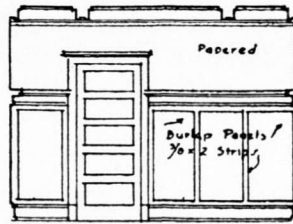


Fig 51B

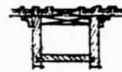


Fig 51C

represent something under the floor, for it is unbelievable that any such elaborate design would occur in the cellar; hence they must represent something up above—a beamed ceiling.

Whenever you encounter dotted lines on a plan, reason them out in a similar manner, and if you will apply your common sense you will have no difficulty interpreting their meaning.

Let us take another illustration, Figure 52, this one from a cellar plan. Here the dotted lines represent a girder on top of the post and a footing underneath the post. Since dotted lines, therefore, may represent something above as well as below any particular part of a building, still greater care must be exercised to interpret them correctly. If at all in doubt as to their meaning, examine the other drawings, such as details, elevations, and sections.

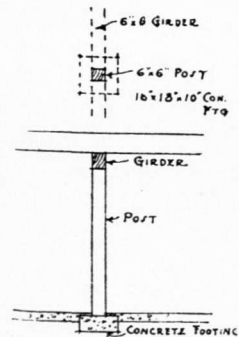


Fig. 52

This brings us to a very important consideration. All plans must be carefully studied, examined, and compared before starting work on them. What you do not find on one plan you will probably find on another plan, elevation, or detail drawing. Also read your specifications carefully. There you will find a full description of the kind and quality of materials to be used. Compare your specifications with your drawings. See that they correspond. Be careful. Be on your guard. Be wide-awake. Take nothing for granted. If at all in doubt, or if you find any mistakes, real or apparent, consult the architect. He has the final say in all matters pertaining to the interpretation of his drawings.

Return to Figure 51(A). Note the line (x) carried completely around the room. Note also that the distance x-x is one-half that of y-y. Hence if y-y represents a full beam, x-x must represent half a beam. Confirm this by referring to the elevation of this room, Figure 51(B).

You will find all drawings, elevations, and floor plans, as well as details, chuck full of notes. These are self-explanatory. They are resorted to when it is difficult to represent the information pictorially, or where they save time and effort. To illustrate: The word "papered" printed on the wall in Figure 51(B) makes it unnecessary for the draftsman to draw the design of a wall paper in that space. In the same figure the note " $\frac{3}{8}$ "x2" strips" gives the carpenter all the information he wants to know, in a brief and concise form, about the framework around the burlap panels.

Problem 17

What does Figure 51(C) represent?

Problem 18 See Figure 51(A).

What kind of doors are shown at (1) and (2)?

What kind of openings are shown at (3) and (4)?

What does (5) and (6) represent?

Figure 51(B) is the elevation of which wall of the room shown in Figure 51(A)?

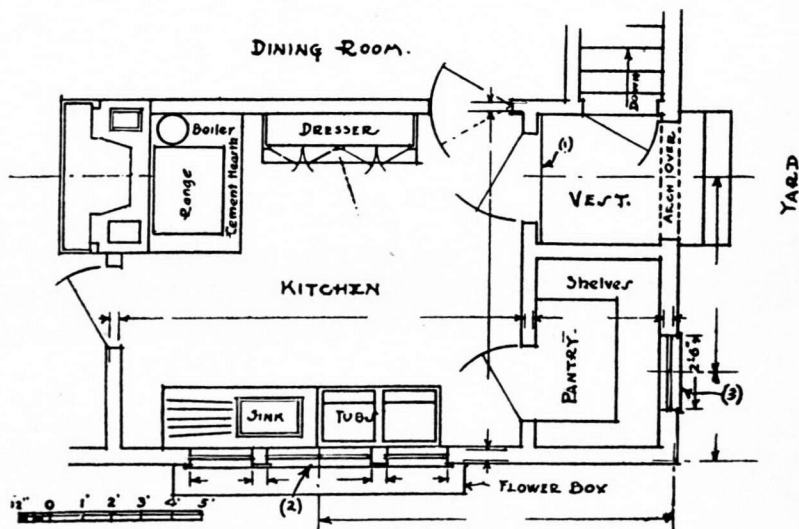


Fig. 53

LESSON 10.—KITCHEN AND PANTRY CONVENTIONS

Conventions for Kitchen Fixtures

Figure 53 shows the most common fixtures found in a kitchen. The sink with its drain board, the tubs with their sloping or inclined front, the dresser or cupboard with its set of double doors, the boiler, range, etc., are all so clearly indicated that they need no further comment. Memorize all the conventions shown on the plan.

Your careful attention is here directed to the manner of showing dimensions. You, of course, know that a partition is made up of 2 by 4 inch studs plastered on both sides. The outside walls are also built of 2 by 4 inch studs, plastered on the inside and sheathed on the outside. In dimensioning a working drawing, however, the plaster and the sheathing are disregarded, and the measurements are taken to the outside of studs.

Problem 19. See Figure 53

1. To what scale is this drawing made?
2. Fill in all the dimensions.
3. How many risers above the yard is the vestibule?
4. What does (1) indicate?
5. What kind of window is shown at (2)?
6. What kind of door do you have to pass through to get from the kitchen to the dining room?
7. Where would you look to find the height of the window shown at (3)?

Conventions for pantry fixtures

The student should have little trouble translating Figure 54. The cupboard covering two sides of the pantry has three drawers underneath one end only.

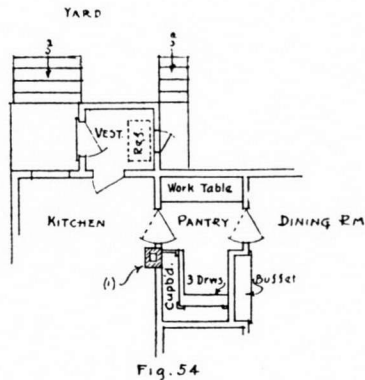


Fig. 54

Problem 20. See figure 54

1. What does (1) indicate?
2. How can you tell that the vestibule floor and the kitchen floor are on the same level?
3. How many risers do you have to go down to get from the vestibule to the yard?
4. The dotted rectangle in the vestibule shows the place for the refrigerator. What special means are provided for the ice man to deposit the ice into the refrigerator?

LESSON 11.—BATHROOM AND BEDROOM CONVENTIONS

Bathroom fixtures

In Figure 55 (A) represents a bath tub, (B) a wash basin, (C) a water-closet, and (D) a medicine case built into the wall. Very often you will find the finish of a room specified on a plan, as here shown. If you do, it is a good policy to check it up with the description given in the specifications to see if they correspond.

Here again the notes and fixtures are so evident that they need no further explanation.

Bedroom fixtures

The dotted rectangle in bedroom No. 2, Figure 56, indicates the position of the bed. The carpenter has nothing to do with this. It is put in there simply for the information of the owner. But what we are most interested in are the closets and their arrangement. Note that there are three closets shown here—one for bedroom marked "No. 1," one for bedroom "No. 2," and one for the "hall." The last is called a hall or linen closet because it is almost always used for the storage of linens.

Now examine the closet marked "(a)." It has two rectangular shelves at one side and two triangular shelves in the opposite corner. Why are these shelves made triangular?

Now examine the closet marked "(b)." How many shelves are shown there? Closet (c), besides having three shelves, has drawers underneath. Where would you look to find the exact number of shelves wanted, and their design?

Problem 21. See figure 57

1. What kind of windows is shown at (1)?
2. How high above the porch is the bedroom floor?
3. Of what material is the chimney built? Locate the plaster around the chimney.

NOTE.—"2x8-16" o. c." means that the floor of this bedroom is constructed of 2"x8" joists, that they are spaced 16" on centers and that they run in the direction indicated by the arrow heads.

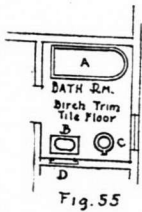


Fig. 55

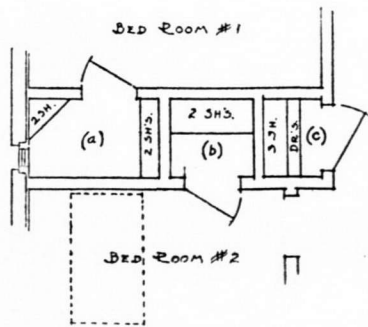


Fig. 56

Problem 22. See Figure 58

1. How many closets are there in chamber No. 1? How many shelves in each closet?
 2. To get from Chamber No. 1 to Chamber No. 2 without going through the hallway, what do you have to pass through?
 3. What does (a) represent?
 4. Why are some of the steps shown in dotted lines?
- Supplementary reading, review paragraph 31.

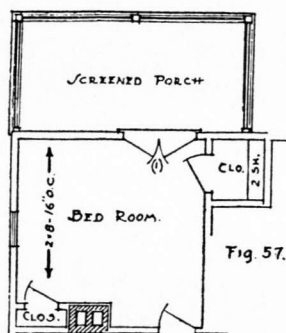


Fig. 57.

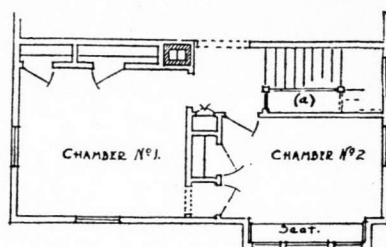


Fig. 58

LESSON 12.—STUDY OF A COMPLETE SET OF PLANS—FIRST FLOOR PLAN

In the previous lessons we have explained the alphabet of architectural drawing. But an alphabet in itself has no value unless combined into words and sentences. Let us, therefore, connect the architectural letters we have thus far learned into plans and elevations and see how simple it is, in the light of our present knowledge, to interpret them.

Problem 23. Figure 59. First-floor plan

(See supplementary set of plans)

1. To what scale is this drawing made?
2. How wide is this house? How deep is it?

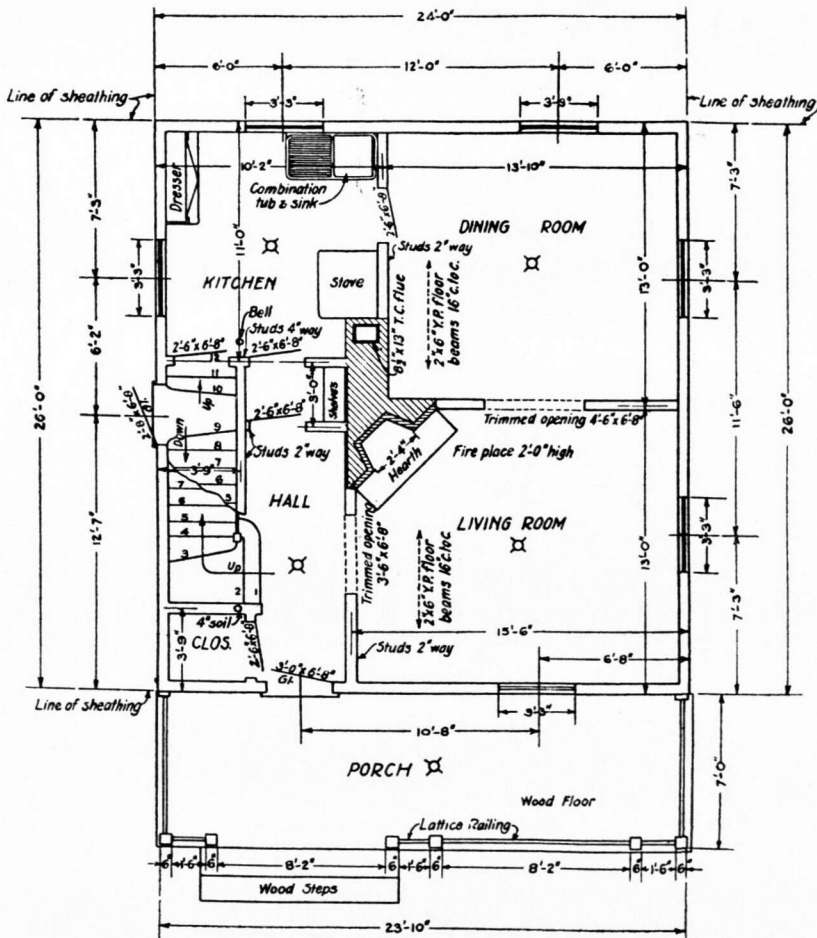
NOTE.—In lesson 10 you were told that dimensions on a plan most often indicate distances between faces of studs. Here, however, they are taken to outside of sheathing and to the center of partitions. This is another proof that there are no laws in architectural drawing, only rules. And you may establish your own rules, if you desire, so long as you indicate those rules or conventions most clearly on your drawing.

3. How many steps from the street to the porch floor? Of what material are they made?
4. How many full posts and how many half posts (see those up against the wall of the building) are there on the porch? Locate the lattice work on the front elevation. Locate the railing on the same elevation.
5. Locate the step leading from the porch to the hall.
6. Give the size, width, and height (see front elevation) of the entrance door. How can you tell that its upper panels are of glass?
7. What is the size of the closet door right off the entrance?
8. To enter the living room from the hall, what kind of opening do you have to pass through? State the size of this opening. Locate the ash pit.
9. Locate the fireplace. Give the width and depth of the opening.
10. How many windows in the living room? What is the size of each (consult front and right side elevations)? How far above the finished floor is each window?
11. Translate the following note: "2"x6" y. p. floor beams 16" o. c." What do the arrow heads indicate? How can you tell that these beams refer to those over the living room and not to those under the living room?

Answer: Look at the cellar plan. See the note "cement floor." No wood beams are therefore needed for the cellar floor. Consequently the note "2"x6" y. p. floor beams 16" o. c." on the cellar plan must refer to the beams up above, on the first floor, and a similar note on the first floor must refer to the beams on the second floor, etc.

12. In the lower left-hand corner of the living room is the note, "Studs 2" way." What does that mean?

Answer: When a stud is placed the 2" way, the 4" face of the stud is exposed to the living room. Then, when 1" plaster is applied on both sides of the stud, we get a partition the total thickness of which is only 4".



FIRST FLOOR PLAN

Fig. 59

13. How do you get from the living room into the dining room?
14. Explain the note between the arrow heads, "2"x6" y. p. floor beams 16" o. c."
15. Explain the note "studs 2" way."
16. Give the length and width of the kitchen in the clear; that is, from plaster face to plaster face.
17. The rear window. Give its width and height. How far is its center from the corner of the building?
18. State the size of the door you have to pass through to get from the dining room to the kitchen.

19. Locate the dresser, sink, tub, stove, boiler.
20. What size flue is used for the kitchen stove? What does the inner rectangle in the flue indicate?
21. What style of window is shown in the kitchen?
22. To get from the kitchen to the yard, how many risers do you have to go down?
23. How many risers in the stairs leading from the kitchen to the cellar?
24. How many risers are there in the front stairs? How many treads? Locate the newel post.

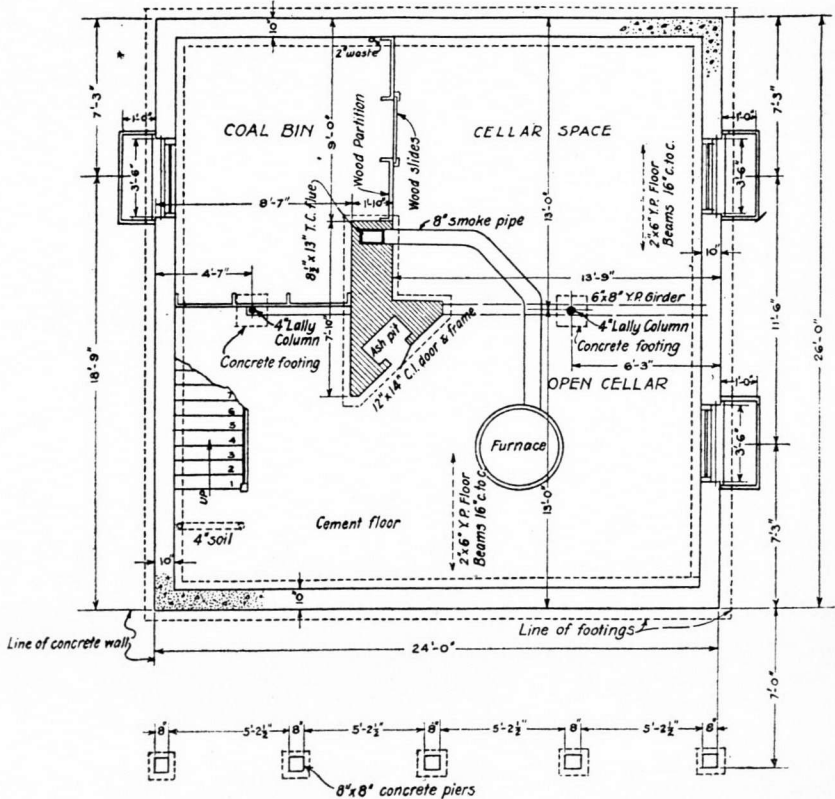


Fig. 60

LESSON 13.—STUDY OF A COMPLETE SET OF PLANS—CELLAR, SECOND FLOOR, AND ROOF PLANS

Problem 24. Figure 60. Cellar plan

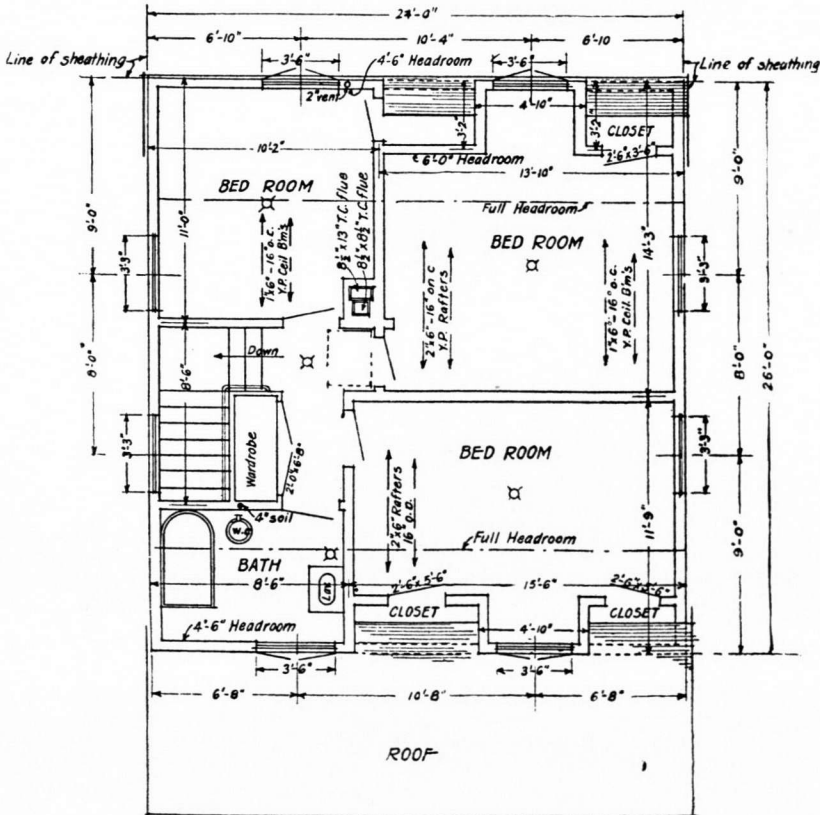
(See supplementary set of plans)

1. Of what material are the cellar walls made? How thick are they?
2. How many windows in all the walls? What is the size (width and height) of each?
NOTE.—These windows, extending below grade, have an areaway in front.
3. What do the dotted lines around the cellar walls indicate?
4. What do the piers in front of the house support?
5. What is the size of all first-floor beams? Of what material are they made? How far apart are they spaced?
6. What size girder is used? Of what material is it made? How is it supported?
NOTE.—Lally columns are made of thin steel shells filled with concrete.
7. Translate the following: "12"x14" c. i. door and frame," which note appears in front of the ash pit.
8. Where are the rest of the cellar stairs shown?
9. How can you tell that the outside face of the concrete foundation wall is flush with the sheathing of the first floor?

Problem 25. Figure 61. Second-floor plan

(See supplementary set of plans)

1. What kind of a step is shown at riser No. 11?
2. What is the height of the door leading into the bathroom?
3. Locate the tub, wash basin, and water-closet.
4. With what style sash is the bathroom window fitted? State its width and height.
5. Give the size of the door leading from the bathroom into the adjoining bedroom.
6. What size rafters are used above this bedroom?
7. Is the ceiling of this room of uniform height throughout?



SECOND FLOOR PLAN

Fig 61

Answer: No. From the partition up to the dot and dash line, marked "Full headroom," it is 8'-0" high. (See dotted lines on right side elevation.) Then it begins to slope down. When it reaches the outside face of the partition forming the closet, the ceiling at that point is 6'-0" high. (See note to that effect.) The height of the ceiling on the inner side of the exterior wall is 4'-6".

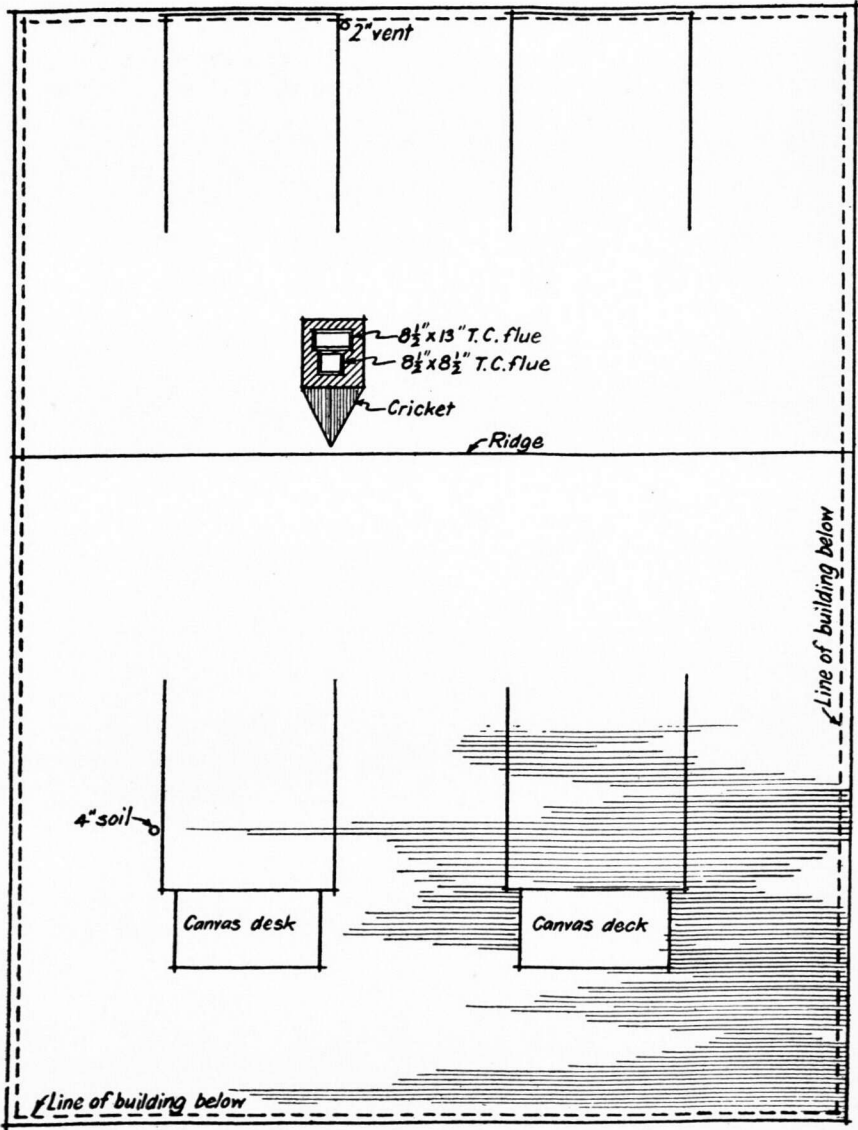
8. Locate the dormer window. With what style sashes is it fitted? How high is it? What is its distance above the finished floor?

9. How high is the side window?

10. Now go back into the hall and enter the adjoining bedroom. Here two sizes of beams are used—2"x6" y. p. rafters and 1"x6" y. p. ceiling beams. What do they signify?

Answer: That the ceiling beams of all the rooms on this floor are 1"x6". (See framing plan, third tier.) And that above these ceiling beams are the 2"x6" rafters. (See framing plan, roof tier.)

11. Give the width and height of all the windows in the bedroom we are considering.



ROOF PLAN

Fig. 62

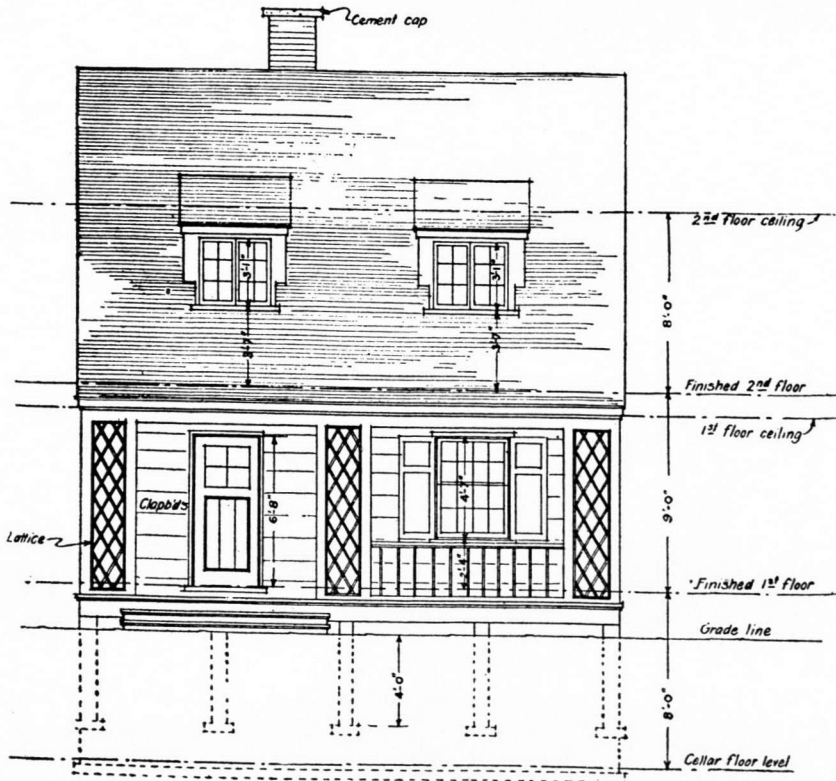
12. Explain what is meant by "headroom."
13. How many closets in this room? Locate the shelf in each.
14. How many closets in the small bedroom adjoining?
15. Locate the chimney and state the number and size of the flues.
16. Return to the hall. How do you get up to the roof? Locate scuttle and ladder.

Problem 26. Figure 62. Roof plan

(See supplementary set of plans)

1. Locate the ridge on the left side elevation.
2. What does the full line on the outside of the building indicate?
3. What does the inner dotted line indicate?
4. Locate the dormer windows on the front and rear elevations.
5. Locate the chimney.

NOTE.—The “cricket” in back of the chimney is made up of two triangular-shaped pieces of wood set in an inclined position to shed the water away from the chimney.

**FRONT ELEVATION***Fig 63A***LESSON 14.—STUDY OF A COMPLETE SET OF PLANS—ELEVATION AND FRAMING PLANS***Problem 27. Elevations. See Figures 63 (A), (B), (C), and (D)*

(See supplementary set of plans)

So many references have been made in the previous lessons to these elevations that their meaning should now be perfectly clear to the student.

1. Why are the dotted lines below grade? What do they indicate?
2. Give the height of the following floors: Second; first; cellar.
3. What do the dotted lines on the second story of the left side elevation represent?
4. Of what material is the chimney constructed? The chimney cap?

NOTE.—Flashings are small pieces of tin, zinc, or copper placed at all joints in a building where leaks are liable to occur.

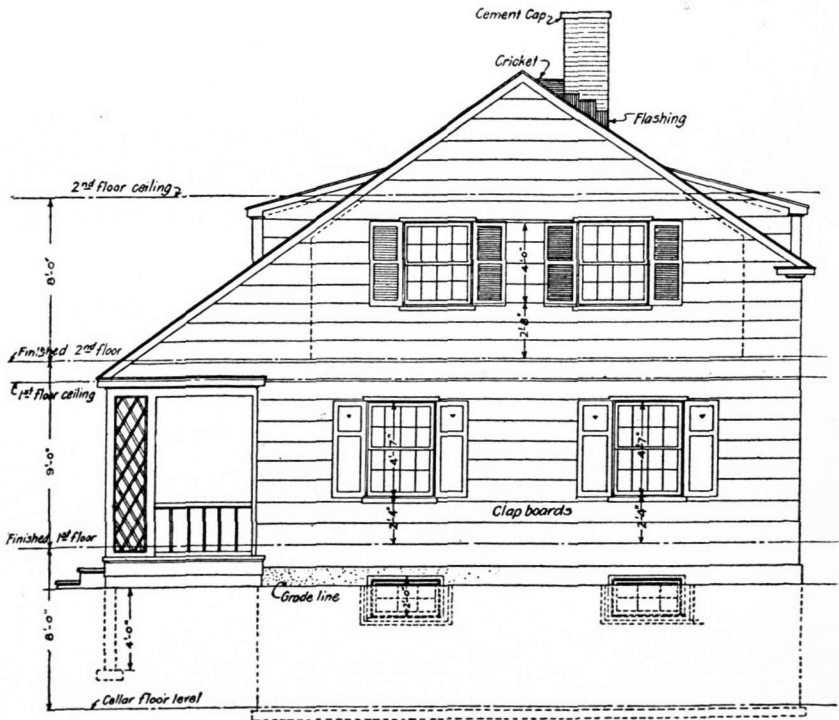
5. Of what material is the exterior covering of the house?
6. How far below grade are the piers supporting the front porch?

Problem 28. Framing plans. See Figures 64 (A), (B), (C), and (D)

(See supplementary set of plans)

First tier:

1. Locate the stair well.
2. Identify all the headers, trimmers, and tail beams shown on this plan.
3. What does "do" signify?
4. Locate the porch beams.



*RIGHT SIDE ELEVATION
Fig 63 B*

Second tier:

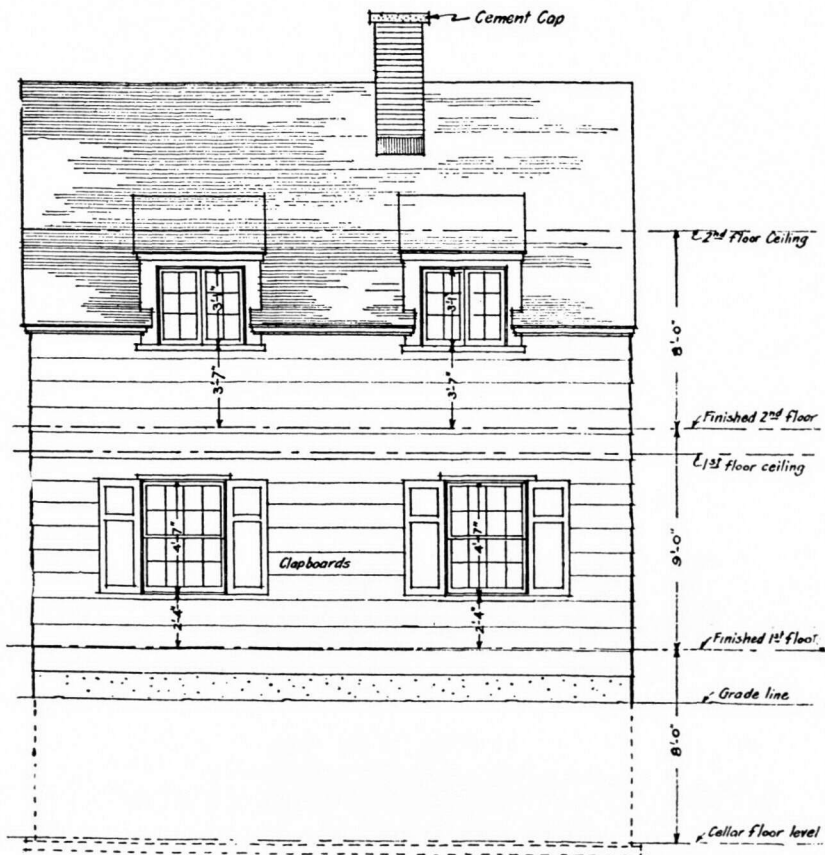
5. Locate the porch rafters.
6. What does the framework in the stair well support? (See second floor plan.)
7. How many rows of cross bridging are shown? What is their purpose?

Third tier:

8. Give the reason for making the ceiling beams smaller in size than other floor beams.

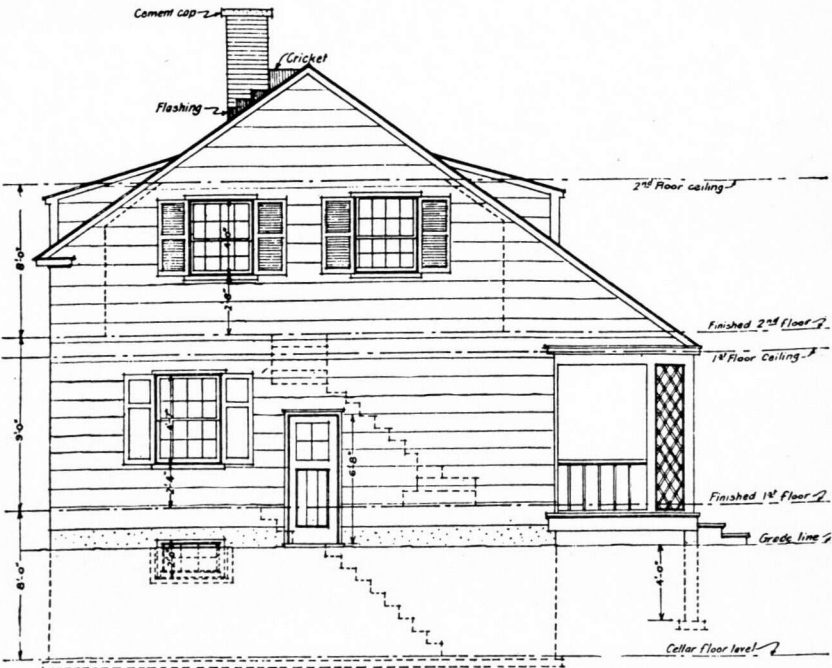
Roof tier:

9. Point out the framing around the dormers.
10. How far apart are all rafters spaced? Beams?
11. What is the size of the ridgepole?

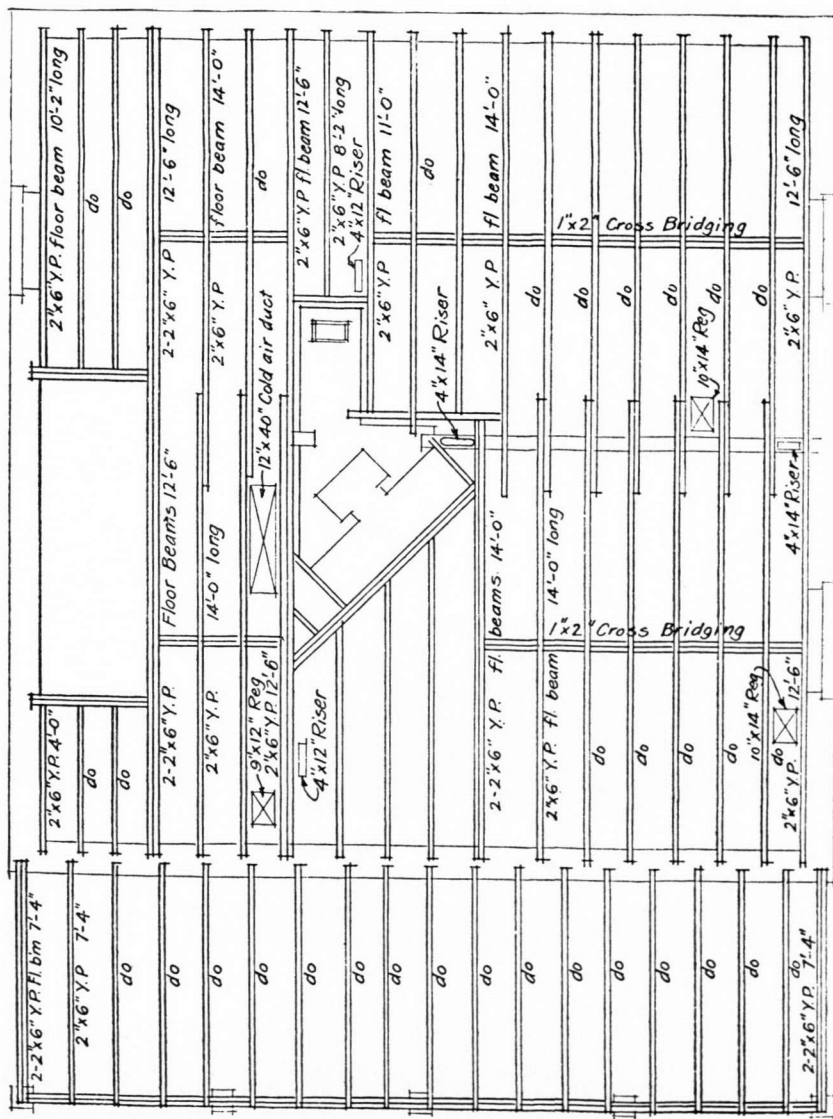


REAR ELEVATION

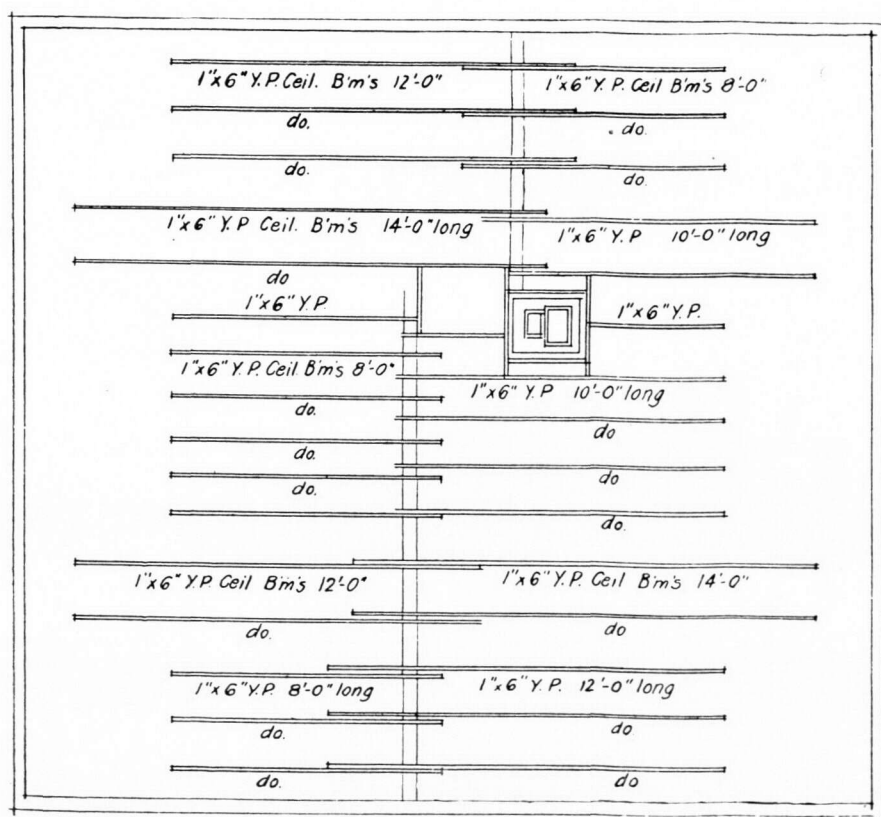
Fig 63 C



LEFT SIDE ELEVATION
Fig 63D



FIRST TIER
Fig. 64 A



THIRD TIER

Fig. 64 C

Rehabilitation monograph. Joint Series No. 54.

Unit Course—Machine Shop Practice 9—Inspection of Machine Parts II

MACHINE SHOP PRACTICE

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. DESCRIPTION OF QUALIFICATIONS OF STUDENTS FOR WHOM THE COURSE IS INTENDED

This unit course is intended for the student who has had enough machine shop experience to understand the very ordinary measuring tools of the machinist, together with some knowledge of linear measurement in inches, and who is able to add and subtract fractions of an inch. He should have a knowledge of decimals, or be so taught that he may be able to add, subtract, divide, and multiply the same and be able to convert fractions of an inch to their decimal equivalents or decimals to fractions. The student who has completed the preceding unit on Inspection of Machine Parts will be able to pursue the work of this course.

2. ATTAINMENT OR ADVANTAGE EXPECTED TO BE DERIVED BY THE STUDENT

It is expected that the student who completes this course will be competent to inspect machine parts, requiring a high degree of exactness in their dimensions and of a somewhat complicated character, thereby enabling him to gain a livelihood in an occupation above the average machinist, with the higher rewards and opportunities consequent thereof. He should be competent to inspect machine parts of the highest type, as well as such tools as jigs, fixtures, and gauges.

3. APPROXIMATE TIME REQUIRED TO COMPLETE THIS UNIT

To complete this unit course the time will vary somewhat, according to the individual and his previous experience. If the student has had only a limited amount of experience, it will be necessary to instruct him to understand and use the measuring tools of precision which are used by the higher-class machinist. If he has taken the preceding unit course or has had an equivalent experience, he might reasonably be expected to complete this course in twenty-four hours.

The distribution of time is given below in connection with the outline of lessons.

4. EQUIPMENT AND MATERIAL

The equipment necessary for this unit should consist of machine parts which require some or all of their measurements to meet a high degree of exactness, such as standard size, or have a limited amount of tolerance, usually expressed in decimals. The parts should be of sufficient numbers to be impressive and should include some unfit parts to enable the student to gain experience in rejecting as well as accepting. These parts may be obtained from many of the large industries and may consist of parts that may have become obsolete.

It is desirable to have sets of the models as shown on the students' instruction sheets in Part 2 of this course. If the school has a machine shop these parts can be produced in sufficient quantity to accommodate a class of any size. No doubt many schools with machine shops would be willing to furnish outfits of these models for other schools having no shops, at a nominal charge.

It will be necessary to have an equipment of the ordinary measuring tools, such as the steel scale, spring calipers, tri-square, combination square, bevel protractor, ring, and plug gauges, etc., as specified for the preceding course. In addition, the following list of the higher-class tools of precision are required for this course:

Micrometer caliper, 1".

Micrometer caliper, 2".

Micrometer depth gauges.

Vernier caliper, 6".

Vernier height gauge, 12"—Brown & Sharpe.

Vernier gear tooth caliper—Brown & Sharpe.

Toolmaker's indicator—the kind recommended is the Boulet universal indicator, made by Boulet Tool Co., Sebago Lake, Me.

An ordinary bench surface plate about 16'' x 24'', with a planed and scraped surface, would be suitable. Can be obtained from Brown & Sharpe, Providence, R. I.

A pair of cast-iron bars about 9'' long planed parallel and square, 1¼'' wide and ½'' thick. The size is unimportant, but they must be exactly the same.

A bridge iron with a set of studs to fit the work, as shown in lesson No. 6.

These tools may be obtained from any of the large dealers in machinists' tools.

The number of tools for each item will be determined by the size of the class. There should be a 1-inch micrometer for each student. One 2-inch micrometer will serve for two or three students. One of each of the other tools listed above will be sufficient for a class of 10 or 12 students.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course, the student should be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school. It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

For this course the student may be rated on a percentage scale based upon the two prime factors in commercial practice in inspecting machine parts, namely (1) accuracy within the limits of tolerance, or adherence to standards, and (2) the time in accomplishment.

6. REFERENCES FOR STUDY

Advanced Machine Work, by Robert H. Smith. Published by Industrial Education Book Co., Boston, Mass.

	Page
Micrometer calipers.....	207
Vernier calipers.....	211
Parallels.....	917
Vernier gear tooth calipers.....	1113
Vernier height gauge.....	1259
Toolmaker's indicator.....	1259

For advanced work study section 12, beginning with page 1201.

Gauges, Gauging, and Inspection. Industrial Press, 140 Lafayette Street, New York. \$2.50.
Micrometer Depth Gauge. (See catalogue of Goodell, Pratt Co., Greenfield, Mass.)

The instructor should also secure catalogues of other manufacturers of micrometers and precision instruments, among which may be mentioned the following, which may be obtained free:

Measuring Book No. 15. J. T. Slocomb Co., Providence, R. I.

Small Tools—Catalogue No. 27. Brown & Sharpe Manufacturing Co., Providence, R. I.

Starrett Tools—Catalogue No. 21. L. S. Starrett Co., Athol, Mass.

Gauges and Standards—1918. Pratt & Whitney Co., Hartford, Conn.

7. OUTLINE OF LESSONS AND TIME ALLOWANCE

	Hours	Minutes
Drill in fractions and decimals-----	2	30
Conversion of fractions to decimals-----	1	
Conversion of decimals to fractions-----	1	
Elementary explanation and application of tools of precision-----	2	30
Blue-print reading (somewhat advanced)-----	2	
Lesson Sheet No. 1. (Use enough parts in all cases to enable the student to become proficient)-----		30
Lesson Sheet No. 2-----		45
Lesson Sheet No. 3-----		45
Lesson Sheet No. 4-----	1	
Lesson Sheet No. 5-----	1	30
Lesson Sheet No. 6-----	1	
Lesson Sheet No. 7-----	1	30
Lesson Sheet No. 8-----	2	30
Lesson Sheet No. 9-----	2	
Lesson Sheet No. 10-----	3	30
	24	

8. SUGGESTIONS FOR CONDUCTING THE WORK

(1) *General information on instruction.*—As this course is intended for the man with some previous machine shop experience, or has finished unit No. I, in the Inspection of Machine Parts, it is assumed that he has all the elementary knowledge needed; therefore any repetition will be unnecessary and will be applied only specifically as the case may require. Stress might be applied in mathematics up to and including decimals and some elementary trigonometry as far as the solution of right angle triangles, as this would prove a valuable asset in the inspection of some of the higher class work. It would also form a ground work for the succeeding unit, as it is essential in tool and gauge work. Another allied study of importance is mechanical drawing, or at least blue-print reading. The tools of precision, their construction and application will be found in reference.

(2) *The presentation of the problem.*—There are two ways in which the problems may be presented. The first is by teaching the necessary mathematics in the ordinary classroom style, giving the student the necessary tools and information as to the manner of procedure and some supervision while performing the allotted task. This method may do for some students, but for others it may fail to create interest or stimulate initiative. The second method consists in giving the first few tasks or problems to the student at once, thereby showing the correlation between the work and the necessary mathematics; likewise by using the tools he could be taught to understand and apply them in a practical manner. As the student realizes the need of the correlated work, his interest would be greatly enhanced. The student should have or be taught some facts concerning mechanical drawing, or blue print reading, and be given enough of the selected parts to acquire experience and judgment.

As the tasks or lessons are arranged progressively, they should be given in their order.

Some of the measuring tools used are finely adjusted and delicately constructed and the pupil should be trained to use them carefully.

While the lessons and drawings are suggestive only, they are the result of much thought and practical experience and could be adhered to closely with much profit to the pupil. It is suggested that any substitutions of exercises should incorporate the principles in the sequence given herein.

It will be noted that each lesson involves a higher degree of refinement and introduces tools of a higher character as the work advances. First, the use of the micrometer is given in connection with the common measuring tools. Next is introduced the micrometer depth gauge with the micrometer caliper and some common measuring tools, together with a greater variety of dimensions. The vernier caliper is introduced and the pupil should be given a good understanding of this tool before using it, as it will be a help to him as he goes along. He will then more readily grasp the principles of vernier height gauge and vernier gear tooth caliper.

The pupil might be given some preliminary work in setting up work for inspection which would involve the use of parallels, "C" clamps, surface plate, angle iron, and bridge iron. He should at least be made familiar with these parts and instructed in the same early in the course. He can then apply this knowledge in his advanced tasks.

STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets comprising Part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENT'S INSTRUCTION SHEETS

GENERAL INSTRUCTIONS

1. Have a clear understanding of what is required either from the instructor or drawing or both.
2. To avoid waste of time, procure all the necessary tools before starting the task and have them convenient and orderly.
3. Follow the order of procedure as laid out in lesson sheets only so far as they may be practical for the task in hand, as they are suggestive only. The order in which they are given is, however, the result of much thought and practical experience.
4. Have a clear understanding of the use of tools required in each task.
5. When in doubt as to the amount of limit allowed, get specific information; also find out functions of the particular part and learn to use judgment from experience.
6. Make a clear written statement of the reason for the rejection of unfit parts.
7. Keep the parts accepted as fit separated from the rejected parts.
8. Return all tools clean and in good order to their respective places when through using.

CONVENTIONS, SYMBOLS, AND ABBREVIATIONS

Learn the following conventions, symbols, and abbreviations used in the lesson and drawing sheets:

Top of Sheet—Rough size and material and number required for one machine.

#1—(Carbon contents.)

O. H.—"Open Hearth" steel.

C. R. or B. D.—"Cold Rolled" steel or "Bright Drawn" steel, no finish required or allowed.

"F" or "f"—Finish all over or where "f" calls for.

(A) (B) (C), etc.—Specify particular place or surface for operation reference.

List—Identifying or catalog number.

.7495 .745 .4385 etc.—Means limits of tolerance, or the maximum and

.7505 .748 .438

minimum dimensions allowance. .7495 means that the dimension must be not less than

.7505

.7495 not greater than .7505.

NOTE.—All measurements which are fixed by the pattern of casting can be disregarded, as they have already been checked in the inspection of pattern.

CLASSIFICATION OF MACHINE PARTS

Each part is classified according to the machine to which it belongs and according to its number in the list of parts of this machine, as well as to its name, which suggests its use or function. For example:

"P. M. 79—*adjusting slide*" indicates that the part belongs to a pounding machine (initials P. M.), that it is number 79 in the parts list of this machine, and that its use is an adjusting slide.

Below is given the initial symbols of the machines from which the parts shown in the drawings are taken:

- E. C. M.—Economy channelling machine.
- E. R. M.—Eppler rolling machine.
- G. A. L.—Gearless automatic leveler.
- N. A.—Naumkeag abraser.
- P. E.—Power eyletter.
- P. M.—Pounding machine.
- R. O. S.—Rotary outside stitcher.
- S. F.—Staple fastener.
- T. E. M.—Tent eyelet machine.

Lesson I

G. A. L. 532—Bracket key
1 13-16''x $\frac{1}{4}$ '' No. 3 O. H. steel "f" all over

1. Study:

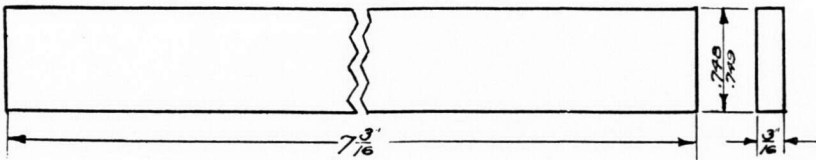
Smith, Advanced Machine Work, pages 207–210.

2. Practice:

- (1) Test width 0.748 with a micrometer caliper.

.749

- (2) Set combination square to 7 $\frac{3}{16}$ '' and try length.
- (3) Measure $\frac{3}{16}$ '' thickness with scale.
- (4) See that ends and sides are fairly square, using combination square.



- (5) Try for straightness with 12'' scale.
- (6) See that all sharp edges and burrs are removed and pieces are properly stamped with identifying number.

3. Equipment necessary:

- 1'' micrometer caliper.
- 12'' scale.
- Combination square.

4. Suggestive questions:

- (1) Why are some dimensions given in decimals and some in fractions?
- (2) What is meant by limits of tolerance?
- (3) How many threads per inch in the micrometer screw?
- (4) Explain how you obtain 1/1000 of an inch in measurement with micrometer calipers.
- (5) To what machine does this bracket key belong?

Lesson II

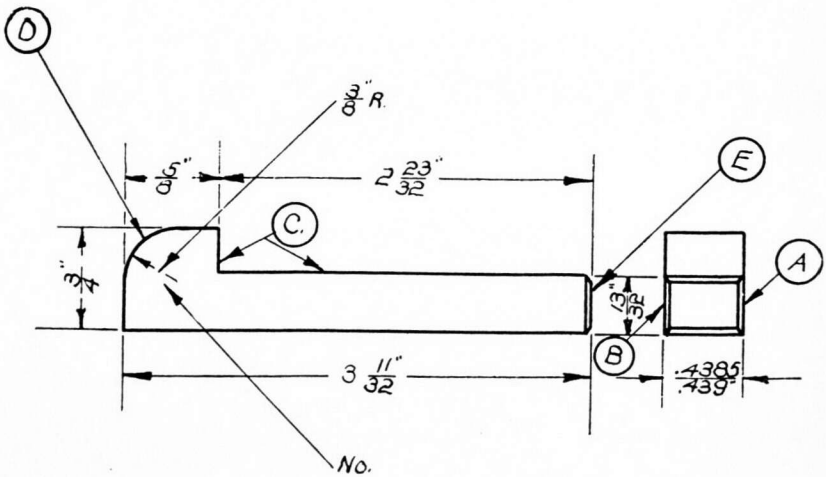
E. R. M. 1251—Gear key
 2 13-16"x1½" No. 3 O. H. steel "f" all over

1. Study:

Smith, Advanced Machine Work, pages 215-223.

2. Practice:

- (1) Test "A" and "B" with 1" micrometer caliper, which must be within the specified limits so that key will drive into a 7/16" standard slot.
- (2) Test 13/32" and ¾" dimension with scale.
- (3) Set combination square to 2 23/32" and test length of step "C."
- (4) Set combination square to 3 11/32" and test length over all.
- (5) Try 3/8" radius at "D" by comparing with a ¾" plug.
- (6) See that sides are reasonably square with bottom, and corner at "C" is reasonably square, using a small steel try-square.



- (7) See that end at "E" is beveled and all sharp corners and burrs are removed and pieces are stamped with identifying number.

3. Equipment necessary:

- 1" micrometer caliper.
- 5" scale.
- ¾" standard plug.
- Combination square.
- 1½" steel try-square.

4. Suggestive questions:

- (1) Why keep the thickness of part within the decimal limits?
- (2) Why are all the other dimensions in fractions?
- (3) Why are all sharp corners removed and ends bevelled?
- (4) To what machine does this part belong?

Lesson III

P. M. 79—Adjusting slide
1—O. H. steel "f" all over

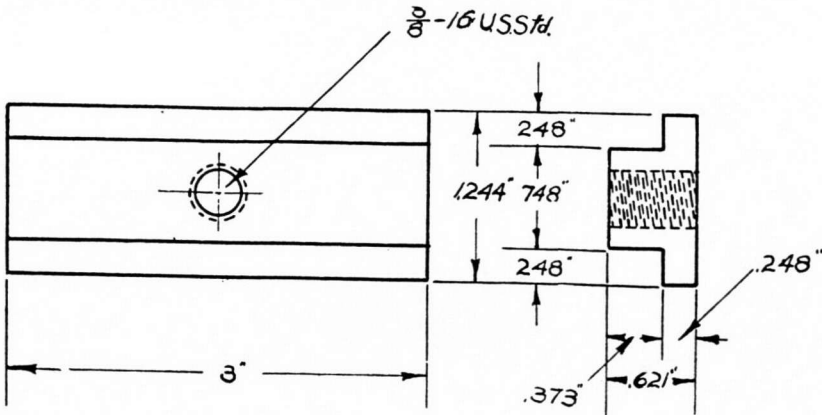
1. Study:

See "Micrometer Depth Gauge," Catalogue of Goodell, Pratt Co., Greenfield, Mass.

Also Advanced Machine Work, pages 313-323. See list of publications.

2. Practice:

- (1) Try length 3" with scale.
- (2) Test tapped hole with $\frac{3}{8}$ x 16 U. S. standard screw plug and measure from screw plug to sides and ends with scale to determine if hole is approximately central.
- (3) Try width 1.244" with 2" micrometer caliper.
- (4) Try 0.748" dimension, 0.621" dimension and 0.248" dimension with 1" micrometer caliper, which takes care of the 0.373 dimension.
- (5) Try 0.248 distance from edge to edge on both sides with micrometer depth gauge.
- (6) See if step is square with side, corner sharp, and side square with bottom, using small try-square. Also see that all sharp corners and burrs are removed and pieces are properly stamped with identifying number.



3. Equipment necessary:

- 6" scale.
- $\frac{3}{8}$ x 16 U. S. standard screw plug.
- 2" and 1" micrometer calipers.
- $1\frac{1}{2}$ " steel try-square.
- Micrometer depth gauge.

4. Suggestive questions:

- (1) Why are nearly all these dimensions given in decimals?
- (2) Why not give the length in decimals?
- (3) How much would you allow over the given figures and pass these parts?
- (4) How much would you allow under the given figures and pass these parts?
- (5) How should the screw plug fit the tapped hole?
- (6) To what machine does this part belong?

Lesson IV

P. E. 315—Spacing link

1—Cast iron

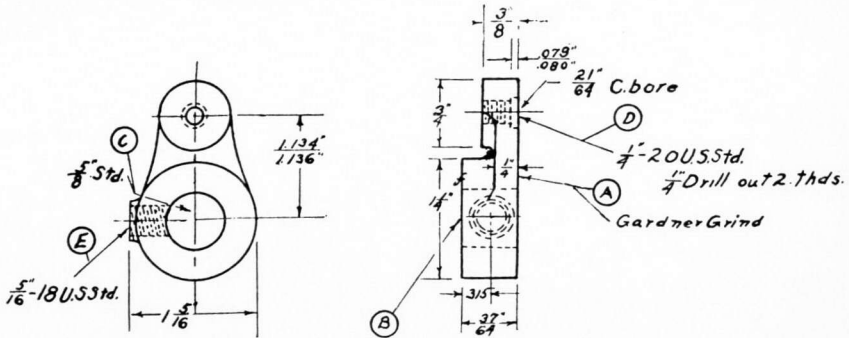
1. Study:

Smith, Advanced Machine Work, pages 318-323.

Goodell, Pratt Co. Catalogue, "Micrometer Depth Gauge."

2. Practice:

- (1) Test thickness "A"—"B" $\frac{3}{8}$ " with scale.
- (2) Test size of hole "C" with a $\frac{5}{8}$ " standard plug and at the same time see that face "B" is square with hole "C," using a small steel square in conjunction with $\frac{5}{8}$ " standard plug.
- (3) Test tapped hole "D" with a $\frac{1}{4}$ " x 20 U. S. standard thread plug.
- (4) Test depth of counterdrilling of "D." Should be at least $\frac{1}{8}$ ", not over $\frac{3}{64}$ " from face "A." Use scale depth gauge.
- (5) Test depth of counterboring at "D" $\frac{0.079''}{0.080''}$ with micrometer depth gauge and try $\frac{21}{64}$ " size with scale.
- (6) Test size of hole "E" with a $\frac{5}{16}$ " x 18 U. S. standard thread plug gauge.
- (7) Test location of hole "E" from face "B" 0.315" by subtracting half the diameter of the screw plug from 0.315". $0.315 - 1562$ equals 0.1588. Insert screw plug in hole and measure the distance 0.1588" from "B" to plug with a micrometer depth gauge.
- (8) Measure distance between holes "B"—"D," $\frac{1.134''}{1.136''}$, by inserting screw plug and standard plug in holes, adding half the diameter of both screw and standard



plugs to $\frac{1.134''}{1.136''}$, which equal $\frac{1.5715''}{1.5735''}$, and measure over outside of plugs with a 2" micrometer. Also see that holes are fairly in the center of bosses.

- (9) Scale dimensions, $\frac{1}{4}$ ", $\frac{3}{4}$ ", $1\frac{1}{4}$ ", and $1\frac{5}{16}$ ".

3. Equipment necessary:

Spacing crank.
 $\frac{5}{8}$ " standard plug.
 $\frac{5}{16}$ " x 18 U. S. standard plug thread gauge.
 $\frac{1}{4}$ " x 20 U. S. standard plug thread gauge.
6" scale.
2" micrometer.
Scale depth gauge.
Micrometer depth gauge.
Small steel try-square.

4. Suggestive questions:

- (1) Can the 9th operation be omitted in this lesson? Why?
- (2) How should the plug gauges fit?
- (3) Why are two threads counterbored away in one tapped hole and not in the other?
- (4) How does the micrometer depth gauge differ in the reading from the micrometer caliper?
- (5) To what machine does this part belong?

Lesson V

G. A. L. 520—Shipper bell crank

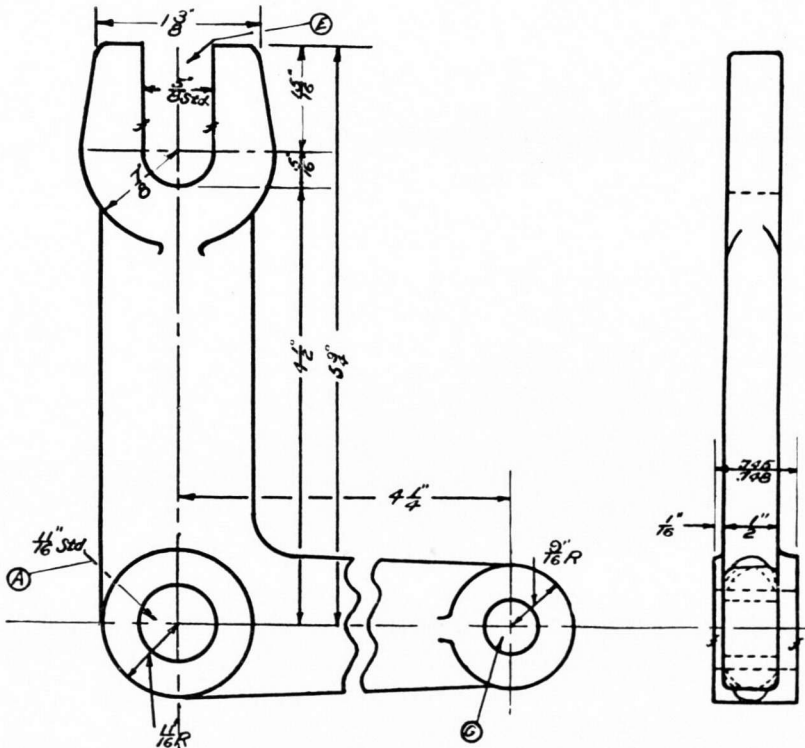
1—Cast iron

1. Study:

Smith, *Advanced Machine Work*, pages 1259–1263.

2. Practice:

- (1) Test size of hole "A" with $\frac{11}{16}$ " standard plug gauge.
- (2) Test size of hole "C" with $\frac{13}{32}$ " plug (free fit).
- (3) Test size of slot "E" with $\frac{5}{8}$ " standard plug, and see that slot is parallel with hole "A" by laying a pair of parallels of the same height on a surface plate. Insert a $\frac{5}{8}$ " plug in the slot and a $\frac{11}{16}$ " plug in hole "A." Rest the plugs on the parallels and see that the plugs touch the parallels at four points.



- (4) See that hole "C" is square with hole "A" and slot "E" by inserting $\frac{11}{16}$ " standard plug in hole "A" and $\frac{5}{8}$ " standard plug in slot "E." Lay on a pair of parallels of the same height and a surface plate with a $\frac{3}{32}$ " standard block under each end of the $\frac{5}{8}$ " plug at "E." Bring the square up to the outside of the $\frac{11}{16}$ " standard plug with the base of square resting on the surface plate and scale the distance from edge of blade of the square to edge of hole "C," $\frac{7}{16}$ ", which equals the difference.
- (5) Insert $11/16$ " plug in hole "A." Subtract one-half of plug ($11/32$ ") from $4\frac{1}{2}$ " ($4\frac{1}{2} - 11/32$ equals $4\frac{5}{32}$ ") and measure distance from edge of hole to bottom of slot with a scale.
- (6) Insert $11/16$ " plug in hole "A" and set a combination square to $5\frac{3}{4}$ ", minus half the diameter of plug, which equals $5\frac{13}{32}$ ", and measure distance from edge of hole to outside of casting at "E."

2. Practice—Continued.

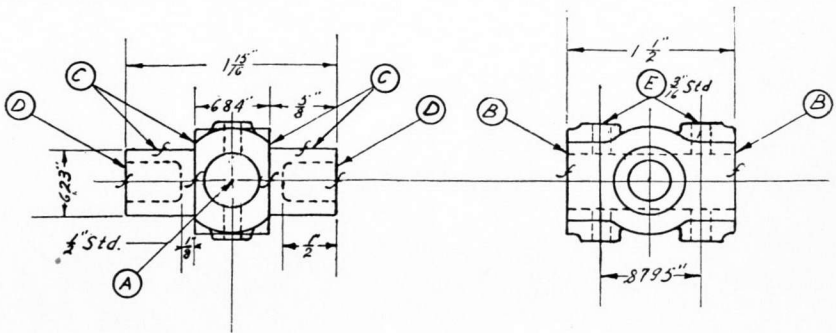
- (7) Insert plug in hole "A," subtract half the diameter of holes "A" and "C" from $4\frac{1}{4}$ " as follows: $11/16 - 11/32$ equals $11/32$, and $15/32 - 15/64$ equals $15/64$. $15/64$ plus $11/32$ equals $37/64$. Therefore $4\frac{1}{4} - 37/64$ equals $37/64$. Therefore $4\frac{1}{4} - 37/64$ equals $3\frac{43}{64}$ ". Take scale and measure distance $3\frac{43}{64}$ " from edge of hole "A" to inner edge of hole "C."
- (8) Scale dimensions at outer end of slotted arm $1\frac{3}{8}$ ", $\frac{7}{8}$ ".
- (9) Set combination square to $1/16$ " and measure distance $1/16$ " from end of hub "B" to rough casting.
- (10) Measure thickness of arms of casting $\frac{1}{2}$ " by scale.
- (11) Use 1" micrometer caliper to measure thickness of hub $\frac{.745}{.748}$ ".

3. Equipment necessary:

$11/16$ " standard plug. $15/32$ standard plug. $5/8$ " standard plug. One pair of parallels. $1/32$ standard size block. Try-square. 6" scale. Combination square. 1" micrometer.

4. Suggestive questions:

- (1) Can operation No. 8 be disregarded? Why?
- (2) What is meant by a pair of parallels?
- (3) What is the difference between a standard size block and standard plug?
- (4) To what machine does this part belong?



Lesson VI

N. A. 67—Crosshead. 1—Malleable iron casting

1. Study:

Smith, Advanced Machine Work, pages 1259-60.

2. Practice:

- (1) Test hole "A" with $\frac{1}{2}$ " standard plug.
- (2) Scale $1\frac{1}{2}$ " dimension from "B" to "B."
- (3) Scale $\frac{5}{8}$ " dimension from "D" to shoulder at "C" both sides.
- (4) Measure dimensions 0.623" on both sides with micrometer caliper.
- (5) Measure thickness 0.684" with micrometer caliper.
- (6) To test whether trunnions are square with hole "A" mount on bridge iron or V block with stud and test with indicator, both sides to register the same on indicator.
- (7) Insert two $3/16$ " standard plugs in the $3/16$ " standard holes; add the whole diameter of one plug to 0.8795" as follows: 0.8795 plus 0.1875 equals 1.067 ", and measure over outside of plugs with 2" micrometer.

3. Equipment necessary:

6" scale.

1" micrometer caliper.

$\frac{1}{2}$ " standard plug.

Bridge iron or V block and $\frac{1}{2}$ " standard plug or stud. (See cut below).

Toolmaker's indicator.

4. Suggestive questions:

- (1) Describe a bridge by sketch or otherwise.
- (2) Describe a V block by sketch or otherwise.
- (3) Explain how a malleable casting differs from ordinary cast iron.
- (4) To what machine does this part belong?

BRIDGE IRON

Cast Iron—Finished all over.

Must be square and true.

BRIDGE IRON STUD*Lesson VII*

S. F. 822—Knife cap. 5-16x7-16 Sand. B. C. steel. (f) all over

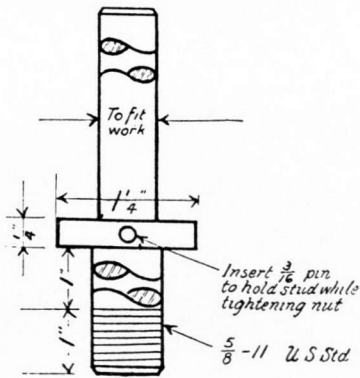
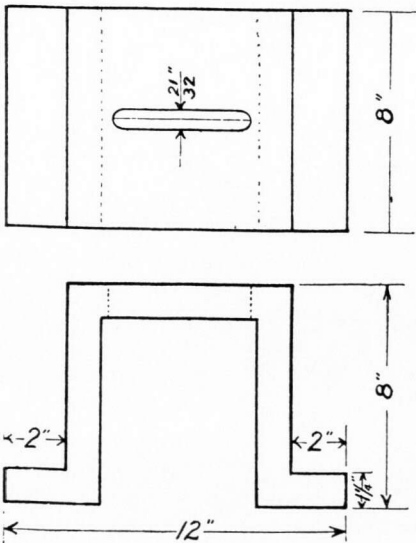
1. Study:

Smith, Advanced Machine Work, pages 207-210.

Goodell, Pratt & Co. Catalogue, "Micrometer Depth Gauge."

2. Practice:

- (1) Scale dimension $\frac{1}{8}"$ at "G."
- (2) Scale dimension $\frac{13}{64}"$ from "A" to "F."
- (3) Scale dimension $\frac{1}{8}"$ at "C."



- (4) Measure dimension $\frac{0.217''}{0.219''}$ from "A" to "G" with 1" micrometer caliper.
- (5) Measure dimension $\frac{0.280''}{0.282''}$ from "A" to "D" with 1" micrometer caliper.
- (6) Measure dimension 0.182"—with 1" micrometer.
- (7) Measure dimension 0.607" with 1" micrometer calipers.
- (8) Insert $\frac{3}{8}"$ standard plug in hole (P). Subtract one-half of its diameter from dimension 0.375" as follows: $\frac{3}{8}" - 0.1875$ equals 0.1875 and $0.375 - 0.1875$ equals 0.1875". Measure distance from "K" to plug with micrometer depth gauge.
- (9) Measure dimension $\frac{0.8735''}{.875''}$ with 1" micrometer caliper.

- (1) Test hole "A" with a 15/16" standard plug gauge.
- (2) Test hole "B" with a 3/8" standard plug gauge. See that holes "A" and "B" are parallel by laying two parallels of the same height on a surface plate. Insert standard plugs in holes and lay on the parallels, the plugs resting thereon at four points.
- (3) Test thickness 7/8" from "C" to "D" by scale and see that "C" is square with hole "A" with try-square and plug.
- (4) Mount on bridge iron or V block with 15/16" stud and see that surface "E" is ground square with hole "A," using indicator.
- (5) Test depth of counterbore at "F" with a scale depth gauge and try 27/64" diameter with scale.
- (6) Test thickness from "H" to "I" $\frac{.248''}{.250''}$ with micrometer caliper and measure diameter of counterbore 37/64 with scale.

2. Practice—Continued.

- (7) Test distance from "I" to "C" by mounting on bridge iron with 15/16 standard stud, using a $\frac{3}{8}$ standard size block and indicator.
- (8) To test distance between the holes "A" "B" add to 3.5625 half the diameter of each plug. What is the sum? Measure over outside of plugs with vernier calipers.
- (9) To test distance between the two holes "A" and "G" add half the diameters of the $\frac{3}{8}$ "x16 U. S. standard screw plug and 15/16" standard plug to 5.375", and measure over outside of plugs with vernier calipers.
- (10) To measure the angle 3° insert 15/16" standard plug in hole "A" and $\frac{3}{8}$ "x16 U. S. standard screw plug in hole "G"; place on a parallel on surface plate, insert a block 9/32" equal to half the difference between the two plugs under the screw plug at "G." This is done in order to bring the centers of the two holes in line with the face of the surface plate. Set bevel protractor to 3° and try the angle with the base of the protractor resting on the surface plate, using a standard size block 9/32" equal to one-half the difference between the plugs 15/16 and $\frac{3}{8}$ ".
- (11) Scale the height from end of hub "C" to face "E" 23/32".
- (12) Scale distance from "C" to center of oil hole, 7/16".

3. Equipment necessary:

- 15/16" standard plug.
- 1" micrometer.
- $\frac{3}{8}$ " standard plug.
- $\frac{3}{8}$ " standard size block.
- Try-square.
- Vernier caliper.
- 1 bridge iron with 15/16" standard stud. (See accompanying sketch.)
- Indicator.
- Scale depth gauge.
- 2 (9/32") standard size blocks.
- Bevel protractor.
- 6" scale.

4. Suggestive questions:

- (1) In what way do vernier calipers differ from micrometer calipers?
- (2) What is the difference between a scale depth gauge and a micrometer depth gauge?
- (3) To what machine does this part belong?

Lesson IX

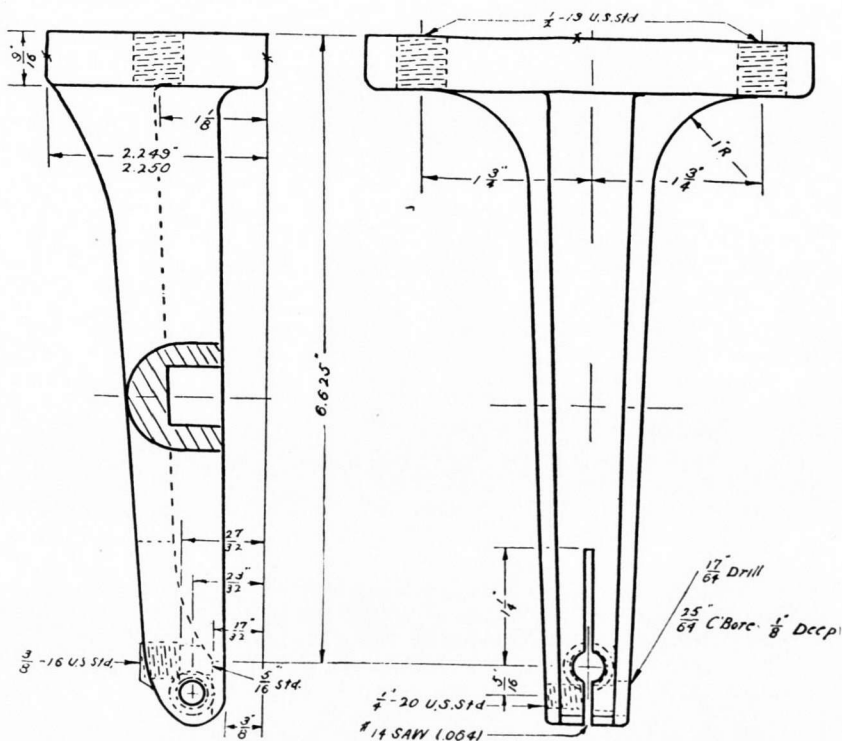
T. E. M. 45—Set horn
1—Malleable iron casting

1. Practice:

- (1) Measure distance $\frac{3}{8}$ " from edge of base to casting by using combination square and measure by scale from blade of square; at same time measure distance 13/32" from edge of base to center of tapped hole, also distance 17/32 from edge of base to bottom of cored slot at top of casting, and distance 27/32 from edge of base to bottom of $\frac{3}{8}$ "x16 U. S. standard tapped hole.
- (2) Test $\frac{3}{8}$ "x16 U. S. standard tapped hole with a standard thread gauge $\frac{3}{8}$ "x16 U. S. standard.
- (3) Test $\frac{1}{4}$ "x20 U. S. standard tapped hole with a standard thread gauge $\frac{1}{4}$ "x20 U. S. standard.
- (4) Test 5/16" hole with a 5/16" standard plug.
- (5) Test 17/64" hole with a 17/64" drill and see that hole is counterdrilled clear to slot.
- (6) Scale distance from center of 5/16" standard hole to bottom of .064" sawed slot $1\frac{1}{4}$ " by scale.

1. Practice—Continued.

- (7) Test width of slot to be at least $1/16''$ by scale.
- (8) Test $1/2'' \times 13$ U. S. standard tapped holes in base with a standard thread gauge $1/2'' \times 13$ U. S. standard.
- (9) Try thickness of base by scale.
- (10) To measure distance from $1/2'' \times 13$ U. S. standard tapped holes to edge of base, subtract one-half of $1/2'' \times 13$ U. S. standard thread plug from $1 1/8''$. Set combination square and measure from edge to screw plug.
- (11) Measure width of base $2.249''$ with vernier caliper.
 $2.250''$
- (12) To measure height 6.625 from base to center of $5/16''$ standard hole, add one-half of the diameter of $5/16''$ hole to 6.625 as follows: Set height gauge and compare height of plug with indicator.



- (13) To measure the location of tapped holes from the center, insert $1/2'' \times 13$ U. S. standard screw plug in one hole. Place against angle iron and clamp there and place on surface plate, screw plug resting on a parallel high enough to clear end. Square finished edge with plate, add one-half of plug to $1 3/4''$ and subtract $5/32''$. Thus insert plug in $5/16''$ hole, getting $1 3/4$ plus $1/4 - 5/32$ equals $1 27/32$. Use combination square to measure the distance $1 27/32''$ from the parallel to the bottom edge of $5/16''$ standard hole. Reverse the casting and measure as before.

2. Equipment necessary:

- 12'' vernier height gauge. Surface plate. Angle iron.
- $1/2 \times 13$ U. S. standard screw plug. Combination square.
- $1/4 \times 20$ U. S. standard screw plug.
- $3/8 \times 16$ U. S. standard screw plug. 12'' scale.
- $17/64''$ drill. "C" clamp.

3. Suggestive questions:

- (1) What is meant by an angle iron? Describe by sketch or otherwise.
- (2) Describe a "C" clamp by sketch or otherwise.
- (3) What is a surface plate?
- (4) How does a vernier height gauge differ from a vernier caliper?
- (5) To what machine does this part belong?

Lesson X

E. C. M. 237A—Knife slide lever

1—O. H. steel

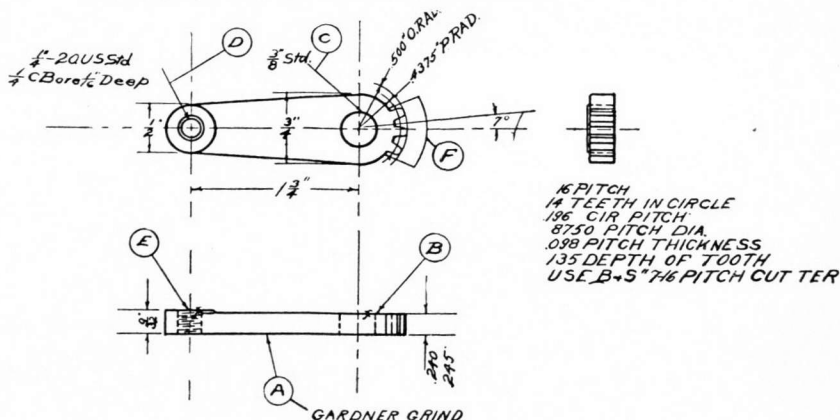
1. Study:

Smith, Advanced Machine Work, pages 1101–1116. (For gearing and vernier gear tooth caliper.)

2. Practice:

- (1) Measure thickness "A-B" 0.240" with 1" micrometer caliper.

$$\frac{.245''}{.245''}$$
- (2) Test tapped hole with $\frac{1}{4}$ "x20 U. S. standard screw plug, using micrometer depth gauge for depth of counterbored hole.



- (3) Measure $\frac{9}{32}$ " thickness, $\frac{1}{2}$ and $\frac{3}{4}$ diameters, with scale.
- (4) Try $\frac{1}{4}$ " counterbored hole and $\frac{3}{8}$ " standard hole with standard plugs.
- (5) Subtract half of each hole from $1\frac{3}{4}$ ", and measure between holes with scale.
- (6) Fasten two $\frac{3}{8}$ " standard bridge iron studs on bridge iron twice the pitch diameter apart between centers, or $\frac{7}{8}$ " plus one diameter $\frac{3}{8}$ equals 1.250, measuring over plugs with 2" micrometer caliper; try two pieces together and see if they run, allowing *no shake*. Remove from studs and with gear tooth vernier caliper set at addendum .0625" and pitch thickness .098". See if they measure the same at pitch line, as one may be thick and one thin and consequently would not duplicate.
- (7) When on studs on bridge iron, place tooth and space on center line and with bevel protractor set at 166° or 14° off center line, with screw plugs in tapped holes and 1/16 standard size block; see if protractor rests on the four plugs.

3. Equipment necessary:

- 6" scale.
- Two $\frac{1}{4}$ "x20 U. S. standard screw plugs.
- $\frac{1}{4}$ " standard plug.
- $\frac{3}{8}$ " standard plug.
- Micrometer depth gauge.
- Bridge iron and two $\frac{3}{8}$ " standard bridge iron studs.
- 2" micrometer calipers.
- Vernier gear tooth caliper.
- Two 1/16" standard size blocks.

4. Suggestive questions:

- (1) Does the vernier gear tooth caliper differ in the reading from the ordinary vernier caliper?
 - (2) How many vernier plates has the vernier gear tooth caliper?
 - (3) What parts of the gear tooth do you measure with the vernier gear tooth caliper?
 - (4) To what machine does this part belong?
-

Rehabilitation monograph. Joint Series No. 55.

Unit Course—Power-plant Operating 2—Starting Up and Closing Down the Electric Plant

POWER-PLANT OPERATING

February, 1919.—Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is planned for the man who has had some experience in the operation of steam boilers and engines. Men who have had charge of the boilers and engines as used by structural and excavation contractors or similar equipment would be well qualified.

Students who have satisfactorily completed unit course No. I—Starting up and shutting down the steam power plant—of this series are eligible for this course.

The applicant should be serious in his desire to understand the study of the subject. The conditions under which a power-plant operator is employed require a man of even temperament and keen judgment in order to meet emergencies. If the applicant appears to be impulsive or of a care-free nature, he should be discouraged in the selection of this work, as the responsibilities are relatively great as compared with other mechanical vocations.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

It is the primary aim of this course to give a general idea of the operation of the fundamental electrical units found in a simple steam power plant used for the purpose of generating electrical energy (direct current). The course should serve as an introduction to the duties involved in generating, controlling, and distributing the electrical energy in a safe and reliable manner.

The term "operation" includes starting the generator, building up voltage, throwing in main switch, throwing in switches on distributing panel, regulating voltage, and closing down the generator.

Upon the completion of the course the student should have a foundation upon which it will be possible for him to build up his own knowledge of the subject, so that in assuming a subordinate position in an engine room he may be expected to advance more rapidly to a position of responsibility.

3. LENGTH OF COURSE

This course is intended to cover about 20 hours of instruction, study, and practical work by the student.

4. EQUIPMENT

It is assumed that the power plant of the reconstruction hospital or of the vocational or trade school will serve as a laboratory for the actual practice work of the student.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers, under the direction of the Surgeon

General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating power-plant operating are available, it is recommended that final rating be recorded as follows: The average student will be rated good, the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in the commercial shop should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor, nor should this rating be influenced by personal feelings, such as dislike or grudge. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

- (a) Time.—Is the student rapid, moderate, or slow in executing his work?
- (b) Technique.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

(2) Finished product:

- (a) Accuracy.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.
- (b) Quality.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) Mastery of principles.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

- (a) Attitude toward work.—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?
- (b) Studiousness.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?
- (c) Possibilities of growth.—Is the student likely in due time to receive promotion to positions of greater responsibility?

(4) Test problem:

A test problem might be given at the conclusion of the course, which would involve all or most of the points covered by the course.

6. OUTLINE OF COURSE

The results obtainable from this course are almost entirely dependent upon the imparting of direct practical knowledge to the student by the instructor. (The Handbook on Engineering, by Henry C. Tully, McGraw Hill Publishing Co., New York, N. Y., might be used by the instructor as a reference, although not strictly up to date.)

The subject matter of the course has been divided into seven lessons in the outline which follows. This outline should be used as a basis for practical talks to precede the task assigned for each lesson. It would be advantageous to make these talks very informal and in the engine room, so that the various points covered may be demonstrated. Acquaintance with the questions asked on the students' instruction sheets will assist the instructor in covering the points given in the outline for each lesson.

To insure results, each student should be provided with a notebook in which he ought to be required to take notes of all important points during the practical talks. These notes offer him a study in preparation for the task to be performed. It is preferable to have the student write answers to all questions on each instruction sheet before proceeding with the next lesson.

LESSON I.—ELEMENTARY ELECTRICITY

- A. Explanation of terms (compare with flow of water in pipe).
 - 1. Voltage (pressure).
 - (a) Unit of measure—volt.
 - 2. Current (rate of flow).
 - (a) Unit of measure—ampere.
 - 3. Power (quantity).
 - (a) Unit of measure—watt.
 - (b) $\text{Watts} = \text{volts} \times \text{amperes}$.
 - (c) $\text{Kilowatt} = 1,000 \text{ watts}$.
- B. Generation of electrical energy.
 - 1. Principle of generator.
 - (a) Moving conductor in magnetic field.
 - (b) Direct current (meaning).
 - (c) Alternating current (meaning).
 - (d) Positive (+) and negative (-) terminals (meaning).

LESSON II.—ELECTRIC GENERATOR

- A. Purpose.
 - 1. Generation of electric power.
- B. Forms (general).
 - 1. Direct current (shunt, series, compound).
 - 2. Alternating current.
- C. Method of driving.
 - 1. Direct connected.
 - 2. Belt drive.
 - 3. Gear drive.
 - (a) Effect of speed (voltage).
- D. Construction.
 - 1. Armature.
 - (a) Winding.
 - (b) Coil.
 - 2. Field.
 - (a) Purpose (formation magnetic field).
 - (b) Winding.
 - (c) Pole pieces.
 - (d) Types (shunt, series, compound) (explain).
 - 3. Commutator.
 - (a) Purpose (take off direct current).
 - (b) Bars.
 - 4. Brushes.
 - (a) Purpose (collect current from armature).
 - (b) Material (carbon, copper).
 - (c) Method of holding.
 - (d) Method of changing position.
 - 5. Terminals.
 - (a) Armature.
 - (b) Field.

LESSON III.—SWITCHBOARD

A. Purpose.

1. Devices for controlling voltage, indicating and distributing current.

B. Construction.

1. Leads from generator.
 - (a) Armature.
 - (b) Field.
2. Main switch.
 - (a) Current supply.
3. Current breaker or main fuse.
 - (a) Protection of generator against short circuits.
4. Meters.
 - (a) Ammeter.
 - (b) Voltmeter.
5. Field rheostat.
 - (a) Voltage regulator.
6. Distributing switches.
 - (a) Fuses.
7. Bus bars.

LESSON IV.—OPERATION OF GENERATOR

A. Careful inspection of all electrical equipment.

1. Cleanliness.
 - (a) Commutator.
 - (b) Brushes.
 - (c) Electrical connections.
2. Examination of parts.
 - (a) Loose connections.
 - (b) Loose bolts or nuts.
 - (c) Lubricating system in order.
3. Brushes.
 - (a) Good contact.
 - (b) Proper position.
4. Main switch open.

B. Starting generator.

1. Start engine slowly.
2. Gradually bring up to speed.
3. Watch lubrication.
4. Watch for sparking at brushes.
 - (a) Brushes out of position.
 - (b) Rough commutator.
 - (c) Poor contact (dirty commutator).
 - (d) Short-circuited armature coil.
 - (e) Open armature coil.
5. Noise.
 - (a) Vibration (out of balance).
 - (b) Brushes.
 - (c) Armature touching pole pieces.
6. Heating.

LESSON V. OPERATION OF SWITCHBOARD

A. Setting of main circuit breaker.

1. Maximum current.

B. Building up voltage.

1. Regulation by field rheostat.

C. Closing main switch.

D. Closing distributing switches.

E. Regulating to a constant voltage by field rheostat.

LESSON VI. OPERATION OF GENERATORS IN PARALLEL

- A. Method of connection.
 - 1. Positive (+) terminals connected.
 - 2. Negative (−) terminals connected.
- B. Purpose.
 - 1. Additional power (same voltage as single unit).
- C. Requirements.
 - 1. Generators of similar characteristics.
 - 2. Equal voltage.
 - (a) Voltage regulation of second unit.
- D. Throwing in main switch of second unit.
- E. Equalization of load.
 - 1. Regulation of field rheostat.

LESSON VII.—CLOSING DOWN GENERATOR

- A. Removal of load.
 - 1. Opening distributor switches.
 - 2. Tripping circuit breaker.
 - 3. Opening main switch.
- B. Shutting down engine.
- C. Cleaning up generator.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the student, one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

GENERAL INSTRUCTIONS TO STUDENTS

- 1. Try to realize the responsibilities of a power-plant operator.
- 2. Think of the result before performing any operation.
- 3. Proceed with caution when opening and closing switches.
- 4. Cleanliness in the engine room tends to make a power plant safe and reliable.
- 5. Keep a complete notebook and use it.
- 6. Write answers to all questions in each lesson before proceeding with the next task.

PUBLICATIONS RECOMMENDED FOR READING

Power, a magazine published by McGraw Hill Publishing Co., New York, N. Y.

Power Plant Engineering, a magazine published by the Technical Publishing Co., 537 South Dearborn Street, Chicago, Ill.

LESSON I

- A. Object.
 - To become generally acquainted with the generation of electricity.
- B. Task.
 - 1. Observe generator at rest.
 - 2. Observe generator in operation.
 - 3. Observe switchboard.
 - 4. Note reading of ammeter.
 - 5. Note reading of voltmeter.
- C. Questions.
 - 1. Explain in your own words how a generator produces an electric current.
 - 2. What does the reading of the ammeter indicate?
 - 3. What does the reading of the voltmeter indicate?
 - 4. What is meant by the term "ampere"?
 - 5. What is meant by the term "voltage"?
 - 6. Determine the power output of the generator from the readings of the voltmeter and ammeter.

LESSON II

A. Object.

To become generally acquainted with a direct-current generator.

B. Task.

Make a general inspection of the generator in order, first, to locate; second, to determine the purpose of; and third, to note the condition of the following parts: (1) Armature, (2) field, (3) commutator, (4) brushes, (5) terminals (if visible), (6) method of driving.

C. Questions.

1. Of what type is the generator shunt, series or compound wound?
2. How many poles?
3. How many sets of brushes?
4. At what speed should it operate?
5. What would be the effect of changing the speed of the engine driving it?
6. Can the position of the brushes be changed? How?
7. How are the brushes held in place against commutator?
8. How can the commutator be cleaned?
9. How are the main bearings lubricated?
10. Can the main bearings be adjusted? If so, how?
11. How can you tell whether a generator will deliver alternating current or direct current?

LESSON III

A. Object.

To become generally acquainted with a direct current switchboard.

B. Task.

Make a general inspection of the switchboard in order, first, to locate; second, to determine the purpose of; and, third, to note the condition of the following parts: (1) Leads from generator, (2) main switch, (3) circuit breaker or main, (4) ammeter, (5) voltmeter, (6) field rheostat, (7) distributing switches, (8) fuses.

C. Questions.

1. Explain the operation of the circuit breaker.
2. Where and why are fuses used?
3. Of what use is the field rheostat?
4. Explain how to use the field rheostat.
5. What material is used for the panels of the switchboard? Why?

LESSON IV

A. Object.

To become acquainted with proper method of starting up and operating a direct-current generator

B. Task.

1. Make thorough inspection of all parts of generator, keeping in mind following important points:
 - (a) Clean and true commutator.
 - (b) Brushes making good contact and in proper position.
 - (c) Tight connections.
 - (d) Main switch open.
 2. Start engine slowly.
 3. Gradually bring up speed.
- Precautions.
- (a) Lubrication of bearings.
 - (b) Sparking of brushes.
 - (c) Noise.
 - (d) Heating.

C. Questions.

1. Give several causes of sparking at brushes and remedy in each case.
2. Give several causes of generator heating.

LESSON V

A. Object.

To become acquainted with proper method of operating a direct current switchboard.

B. Task.

1. Generator should be turning over at full speed.
2. Regulate field rheostat to build up voltage to desired point.
3. Close main switch.
4. Close distributing switches.
5. Regulate field rheostat to give constant voltage at varying loads.

C. Questions.

1. What should be done if the engine becomes overloaded and begins to slow down?
2. What effect will this have upon the voltage.
3. What should be done if the circuit breaker trips out?

LESSON VI

A. Object.

To become acquainted with the operation of generators in parallel.

B. Task.

1. Start up a second generator.
2. Bring up to speed.
3. Build up voltage to equal voltage of other machines.
4. Throw in main switch.
5. Keep load on generators equalized.

C. Questions.

1. What is the purpose of operating generators in parallel?
2. What precautions must be taken before throwing in main switch of second generator?

LESSON VII

A. Object.

To become familiar with proper method of shutting down a direct current plant.

B. Task.

1. Open distributor switches.
2. Trip circuit breaker.
3. Open main switch.
4. Shut down engine.
5. Clean up generator.

C. Questions.

1. How would this procedure differ in case two generators were operating in parallel?

Rehabilitation monograph. Joint Series Nos. 56-57.

Unit Course—Telegraphy 1, 2—Sending and Receiving for the Beginner

TELEGRAPHY

February 1919. Trial edition

TELEGRAPHY 1—SENDING FOR THE BEGINNER.—PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS NECESSARY

Only a very ordinary school education is really necessary for one to become a successful telegrapher, and no previous experience or knowledge of the craft is required. Indeed, the majority of successful telegraphers have enjoyed only a common-school education. It is quite possible for one with even a fifth-grade education or its equivalent to become a successful telegrapher.

When one learns telegraphy, it is not necessarily with the idea that he will always be a telegrapher, but rather with the idea that it will lead him on to some position very remunerative and of considerable importance. It has been authoritatively stated that more than 80 per cent of the railway and commercial telegraph officials have begun as railway telegraphers.

2. THE INTENT OF THIS COURSE IS—

1. To teach the initial step in telegraphy, assuming the correct position of the hand and movement of the arm, afterwards memorizing and executing the Morse code.
2. To teach the student to distinguish between dots and dashes and spaces (interims) so that he may distinguish one from the other and to master all of this so that he will not think of any combination of characters as so many dots and dashes or spaces, but rather for what they indicate, so that the combination will instantly suggest the telegraphic character.
3. To teach the student a knowledge of the instrument and the simple Morse circuit the make-up and function of the key and its adjustment, the sounder, batteries (both dry and gravity), their make-up and care.
4. To impress the student with the importance of accuracy over speed. It is the usual tendency of telegraph students to endeavor to send too rapidly.
5. To train the student in correct punctuation in transmitting, receiving, copying, and breaking.

3. LENGTH OF COURSE

This course should cover at least 13½ hours of study, practice, and instruction, most of the time being devoted to paragraphs 2 and 4 of "The Intent of this Course" given above.

4. EQUIPMENT AND MATERIALS

1. The following equipment should be provided for a class of 15 students:

Eleven telegraph keys (leg).
 One telegraph key (legless).
 Four 1892 4-ohm Giant sounders (brass levers).
 Ten 4-ohm sounders (aluminum levers).
 Three resonators (standard Western Union pattern).
 Six union lightning arrester cut-outs.
 Twenty-six No. 6 dry cells.
 One 7-wire (14-strap) pin-plug switchboard.
 Two 3-cell metal cases for dry batteries.
 Ten 2-cell metal cases for dry batteries.
 Five pounds No. 16 annunciator wire.
 Fifteen copies Dodge Telegraph Instructor—\$1.25.

The following equipment should be provided for demonstration purposes:

One gravity battery, size 6 by 8, complete.
 One 4-ohm aluminum lever Giant sounder.
 One standard telegraph relay, 150-ohm.
 One 3-wire (6-strap) Western Union pin plug, with board.
 Two tables 3 feet by 9 feet by 31 inches high.
 One bench 16 feet long by 2½ feet wide by 31 inches high, with back board 10 inches high, partitioned into six divisions. Mount on each compartment of this bench one leg key, one 4-ohm sounder, and one lightning arrester cut-out.
 One teacher's desk, with one 3-drawer pedestal. On this desk is mounted one legless key and one sounder. Underneath place one 2-cell metal battery case. (These items are included in list given above.)
 One bench 8 feet long by 2½ feet wide, 27 inches high, for typewriters. On this bench mount three resonators and three leg keys (mentioned above). Underneath place three 2-cell battery cases (mentioned above).

NOTE.—Only the best grade of equipment should be provided.

The equipment listed above may be secured from either of the following firms:

J. H. Bunnell Co., 32 Park Place, New York City.

Manhattan Electrical Supply Co., 17 Park Place, New York City.

5. SUGGESTIONS FOR TEACHING

The teacher should give each student individual instruction and frequently listen to his style of sending, criticising in particular any imperfection that may appear in the position of the hand, the arm movement, or formation of telegraphic characters, always cautioning the

student to send slowly so the characters will be accurate. Impress him with the fact that speed will invariably be obtained unconsciously. Too much stress can not be placed upon the importance of the accurate formation of letters.

Many students of telegraphy labor under the erroneous opinion that the only real essential feature for him to accomplish is to receive. It is just as important that he learn to send accurately, so that the operator with whom he is working can copy that which is being sent. Likewise, impress the student with the importance of making a legible copy.

There is a certain element of individuality that enters into each person's style of sending. It has been truly stated that there are as many different styles of "key sending" as there are styles of penmanship. Operators working with one another, although at great distances, readily detect the sending of another operator with whom they are acquainted almost as readily as they would recognize his voice. Some will employ a "heavy style" of sending, while others will have an extremely light touch. Some employ a quick and nervous touch of his key, while others a smooth, regular, uniform movement. Students should be taught to acquire the latter. Each dot and dash of every letter should be made with the same uniformity of pressure upon the key. The tension of both the key and sounder springs is adjustable.

The student should be impressed with the importance of forming letters so that the one to whom he is sending will have no difficulty in readily recognizing the telegraphic characters. Teach him, if possible, that expression and harmony should accompany accurate sending. Our best pianists have these qualities, and likewise our best telegraphers. Uniformity of space between each letter and each word is highly essential.

6. MEASURING, RATING, AND RECORDING STUDENTS' WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers, under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second schools.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording the work of students.

Upon completing this course the student should be able to send accurately five words per minute. The instructor should give such tests as necessary to ascertain the student's proficiency.

The book recommended for the student, and to which references are made in this course, is Dodge's *The Telegraph Instructor*, published by the author, Mr. G. M. Dodge, president of Dodge's Institute of Telegraphy, Valparaiso, Ind. Price \$1.25, list.

The student should also be made acquainted with the American official telegraphic publication, *The Telegraph Age*, published by Mr. John B. Taltaval, 253 Broadway, New York City.

SENDING FOR THE BEGINNER.—PART 2. STUDENTS' INSTRUCTION SHEETS

[Introduction: Read pages 3-6 of Dodge's *Telegraph Instructor*]

LESSON I

1. Read pages 30-35 of *Telegraph Instructor*.

2. Practice. Learn the movement by making dots and dashes slowly, taking the dots first, making one each second, then two and three each second. Afterward undertake the dashes in the same way.

NOTE.—The great advantage in attaining the movement by making dots and dashes instead of the letters is in the fact that one's mind is taxed with nothing else, while with the letters the mind is usually concentrated upon the formation of them.

LESSON II

1. Practice the following slowly and in the order given. Repeat at least 30 times:

e	i	s	h	p	6
.
o	c	r	y	z	&
.

LESSON III

1. Practice the following in the same manner as in the preceding lesson:

t	l	m	5	0
—	—	—	—	—
a	u	v	4	
—	—	—	—	
n	d	b	8	
—	—	—	—	

LESSON IV

Read paragraph on "Formation," pages 33 and 34.

Practice the following as in preceding lessons:

f	g	j	k
—	—	—	—
q	w	x	1
—	—	—	—
2	3	7	9
—	—	—	—

LESSON V

Practice the following as in preceding lessons:

Period (.)	Comma (,)	Interrogation (?)
—	—	—
Exclamation (!)	Paragraph (drop a line)	
—	—	
Dollars (\$)	Cents (¢)	Dash (—)
—	—	—

LESSON VI

Memorize all the telegraphic characters as they appear in preceding lessons. A most excellent way to do this is to copy the alphabet on a sheet of paper, remove these lesson sheets, and then endeavor to fill in after each letter numeral, and punctuation mark and the correct telegraphic characters. When this is completed, take the lesson sheet and ascertain the accuracy of the characters that you may have written.

NOTE.—All the punctuation marks as shown in the sixth exercise of page 33, Dodge's Telegraph Instructor, are really unnecessary for the beginner to memorize, but should be memorized at a later time.

LESSON VII

Practice sending, slowly, all of the following words:

Aim, Buy, Care, Dove, Easy, Farm, Good, Hill, Ice, Jot,
Keep, Life, Many, None.

Repeat at least 20 times.

LESSON VIII

Practice sending, slowly, the following sentences:

"Every cloud has a silver lining."
 "Time and tide wait for no man."
 "A rolling stone gathers no moss."

Repeat at least 20 times.

LESSON IX

Practice sending, slowly, the following numerals and fractions:

86, 921, 3,255, 72,400, 856,000

$\frac{1}{8}$ $\frac{1}{2}$ $\frac{2}{5}$ $\frac{3}{7}$ $\frac{1}{16}$ $\frac{3}{32}$

Repeat at least 20 times.

NOTE.—The comma or a space should be employed in dividing numerals into thousands. In the fractions a dot (the letter "e") represents the bar of division; hence the fraction $\frac{1}{2}$ would be transmitted as 1e2; $\frac{3}{32}$ as 3e32.

LESSON X

Practice.—Review the exercises in Lessons VII, VIII, and IX at a speed of five words per minute. Repeat at least 10 times, or until your sending meets the approval of your instructor. Practice sending at the same speed "new matter" from a magazine or newspaper.

After completing all of the foregoing lessons, it is assumed that you have acquired the ability to send accurately short words and sentences at the minimum speed of five words per minute.

GENERAL INSTRUCTIONS TO THE STUDENT

After completing unit course No. 1, whereby you have learned to send accurately at the rate of five words per minute, you should now learn to receive by having some efficient sender send you letters or matter with which you are not acquainted, and you should pronounce each letter as made, and the sender should, in turn, pronounce the word at the completion of it. Do not, however, neglect that which you have attained in unit course No. 1. The handling of the key is not unlike the playing of a piano or any other instrument, where the arm and hand play an important part. You should, therefore, "keep everlastingly at it" with the telegraphic key. Again we caution you not to forget that your practice in sending must be kept up.

From now on the art of receiving will depend upon your application and aptitude. Endeavor at all times to make your copy legible, for that is as essential as the reception and recognition of telegraphic signals.

After acquiring the ability to send and receive at the rate of five words per minute as prescribed in this unit, you will be ready for more advanced, more difficult, and much more interesting features of the work.

TELEGRAPHY 2.—SENDING AND RECEIVING FOR THE BEGINNER

1. QUALIFICATIONS OF STUDENT

This course is planned for the student of telegraphy who has completed in a satisfactory manner the instruction, training, and practice as outlined by unit course, telegraphy 1.

2. THE INTENT OF THIS COURSE IS—

- (1) To qualify the student in becoming perfectly familiar with the code for both sending and receiving purposes.
- (2) To drill the student in receiving the letters as they are made by the sender and to call them.
- (3) To drill the student to the point of becoming able to pronounce short words as they are made by the sender.

3. LENGTH OF THE COURSE

This course is intended to cover about 25 hours of study and alternating practice of sending and receiving, the greater part of the time being given to receiving or calling the letters and later short words as they are made by the sender.

4. EQUIPMENT AND MATERIAL

One set of instruments (key and sounder, with batteries) should be placed upon a square table accommodating seven students besides the instructor. The key and sounder in this case should be separate and connected with wire rather than upon one base. The 1892 Giant sounder (Bunnell make) is recommended for this purpose. Two dry cells should be connected in with this circuit. The circuit, however, when not in use should always be left open, and it is therefore advisable that the circuit closers of the key be removed.

5. SUGGESTIONS FOR TEACHING

At this stage of the instruction individual attention is not so necessary, but students with equal ability should be placed upon the same table, and in the beginning those who can pronounce letters only should be placed at the same table.

After having qualified per unit course No. 1, where each student required more or less individual attention, they may now be grouped at a table with from five to eight—not more than eight—all of as near equal qualifications as possible in sending, or grouped as near together as possible so that all may listen to one sounder while they take turns sending very short words; each or all students calling or pronouncing the letters as made and as they catch them—the sender pronouncing the word at its completion.

After the students have become able to call accurately the letters, they should be given short words and requested to wait until the end of the word and then pronounce it.

While at this point the students may be handled as a class or table rather than individually, still it is imperative that the instructor continue to criticise each student's sending, impressing upon him the importance of accuracy above speed, for here is where the average student cultivates the idea that he must speed up and consequently sacrifices accuracy in so doing. The instructor should also give frequent drills and tests in receiving from his own hand and thus overcome any inaccuracy students may have acquired through receiving from other students.

6. USE OF TEXTBOOK

Continuous reference to the textbook, after the foregoing has been attained, is really unnecessary at this particular time, as the student's progress lies almost altogether in the application he gives the study and his natural aptitude for the work. At a later time, however, and beyond the work covered in this unit, and when one must become acquainted with the rules, traffic regulations, etc., of the railway and commercial telegraph companies, the student should be urged to study Dodge's Telegraph Instructor. A splendid plan is to use the text in the book for sending and receiving; in this way, the student will procure the practice he desires and at the same time become familiar with the contents of the textbook in which he should be interested.

7. STANDARDS FOR RATING STUDENT'S WORK

When the instructor has determined by suitable tests that the student can receive correctly at the rate of five words a minute, the certificate for completion of this unit may be given the student.

Rehabilitation monograph. Joint Series No. 58

ELECTRICITY

Unit Course—Electricity 2—Annunciator Wiring

February, 1919. Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course may be taken by a student whose education is limited to the first six years of the elementary school and who is physically able to perform the tasks specified. While the subject has a fascination for the average man, the student should give evidence of an interest in the subject beyond mere curiosity or entertainment before being permitted to enter upon the course. In other words, he should have a serious purpose.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

This course will enable the janitor or home owner to judge the quality of work done by others or to acquire sufficient skill for installing simple annunciator systems. Soldiers whose occupations before entering the Army were unprofitable or uncongenial, who felt that they were failures in the work that they had selected, may try again in a new field with the possibility of success.

This unit is one of several courses in electrical wiring and installation. The student who masters the details of this unit will have made an excellent start toward a thorough training as an electrical mechanic, an occupation in which workers are well paid and rarely unemployed.

3. LENGTH OF THE COURSE

It is estimated that the average man can complete this unit course in 30 hours of study and practical work.

4. EQUIPMENT AND MATERIAL

The structure described in the drawing submitted with unit course, electricity 2, Bell wiring, is recommended to be built in a room not less than 25 feet wide, 40 feet long, 10 feet from floor to ceiling. This room should also be equipped with a closet under lock and key provided for the convenient arrangement of tools and electrical supplies.

If it is possible to obtain an old private residence for the work, the conditions would be ideal. Should this be impossible, the equipment may be installed in a factory or loft.

The tool equipment should include both individual kits to be provided for each student and a general outfit of tools less frequently used, which may be shared by the whole class.

Individual kit:

- One pair 7-inch side-cutting pliers.
- One No. 13 bell-faced nail hammer.
- One 2½-inch Champion screw driver.
- One midget (Valley Pet) screw driver.
- One drawing board 30 inches wide, 36 inches long.
- One single-blade jackknife.

General tools and equipment recommended for a class of five students (increase the number of each item according to the size of class):

- Two 5-foot spreading step ladders.
- Two $\frac{1}{16}$ -inch auger bits.
- Two $\frac{1}{8}$ -inch auger bits.
- Two $\frac{3}{16}$ -inch auger bits.
- Two $\frac{1}{2}$ -inch auger bits.
- Two ratchet braces, 8-inch sweep.
- Two $\frac{1}{2}$ -inch bell hangers' bits, 18 inches long.
- Two 12-inch compass saws.

Two $\frac{1}{2}$ -inch wood-cutting chisels.
 Two 1-inch wood-cutting chisels.
 One flat file 8 inches long.
 One 6-inch try square.
 Two $\frac{5}{16}$ -inch star drills.
 One hack-saw frame, 8-inch.
 12 8-inch hack-saw blades.
 One 16-inch cross-cut handsaw.
 One 16-inch rip handsaw.
 One steel block plane.
 One hundred feet $\frac{1}{8}$ -inch standard fish wire.
 Two extension bit holders.
 Five brad awls.
 Five manual reset 4-point needle-drop annunciators (manufactured by Manhattan Electrical Supply Co., New York, N. Y.).
 Five manual reset 4-drop gravity-drop annunciators (manufactured by W. R. Ostrander & Co., New York, N. Y.).
 Six individual electrical reset 4-drop semaphore lock-drop annunciators (manufactured by Edward & Co., New York, N. Y.).

The amount of supplies recommended for a class of five students during a period of 30 hours is as follows:

Fifteen pounds No. 18 B. & S. gauge annunciator wire in assorted colors.
 Fifteen pounds No. 18 B. & S. gauge damp-proof office wire in assorted colors.
 Five pounds $\frac{3}{8}$ -inch square-head staples.
 One gross $1\frac{1}{2}$ -inch No. 5 flat-head bright wood screws.
 One gross $1\frac{1}{2}$ -inch No. 8 flat-head bright wood screws.
 One gross $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws.
 Two hundred No. 6 Blake insulated staples.
 Twenty-four $\frac{1}{8}$ by $\frac{3}{4}$ inch lead expansion sleeves.
 Twenty-four $\frac{3}{16}$ by 4 inch Ajax toggle bolts.
 Fifty wood push buttons.
 Twenty No. 6 dry battery cells.
 Five pounds $\frac{3}{4}$ -inch friction tape.
 Twelve soft lead pencils.
 Six wrought-bronze loose-back push buttons.

It is suggested that the annunciators be obtained from the manufacturers mentioned, because all drawings included in the course are of instruments made by them, respectively. They are standard types.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is desirable, therefore, to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available, it is recommended that final rating be recorded as follows: The average student will be rated good; the student of exceptional ability will be rated excellent, while the student of lesser ability will be rated fair. The student producing work of a quality that would be rejected in the commercial shop should be rated poor.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

- (1) Execution of work.
 - (a) Time.—Is the student rapid, moderate or slow in executing his work?
 - (b) Technique.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?
- (2) Finished product.
 - (a) Accuracy.—Should be determined by the record kept of errors in measurement, etc.
 - (b) Quality.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
 - (c) Mastery of principles.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?
- (3) Interest.
 - (a) Attitude toward work.—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?
 - (b) Studiousness.—Does the student show disposition to study the printed literature related to his work? Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) Possibilities of growth.—Is the student likely in due time to receive promotion to positions of greater responsibility?

6. OUTLINE OF LESSONS OR JOBS

- I. The study of a manual reset needle-drop annunciator. Time, 1 hour 30 minutes.
- II. An exercise in exposed work wiring for a manual reset needle-drop annunciator with push buttons centrally located. Time, 2 hours.
- III. The study of a manual reset gravity-drop annunciator. Time, 1 hour 30 minutes.
- IV. An exercise in exposed work wiring for a manual reset gravity-drop annunciator with push buttons located at separated points. Time, 2 hours.
- V. The study of a semaphore-lock gravity annunciator equipped for individual electrical resetting. Time, 2 hours.
- VI. An exercise in exposed-work wiring for two-semaphore lock gravity-drop annunciators equipped for individual electrical resetting and operated by push buttons centrally located. Time, 3 hours.
- VII. An annunciator equipment for a small business office; location of outlets. Time, 1 hour.
- VIII. An annunciator equipment for a small business office; installing the wires. Time, 4 hours.
- IX. An annunciator equipment for a small business office; testing and identifying wires. Time, 2 hours.
- X. An annunciator equipment for a small business office; set and connect annunciator, push buttons, and battery. Time, 2 hours.
- XI. An annunciator equipment for a private residence; location of outlets. Time, 2 hours.
- XII. An annunciator equipment for a private residence; providing runways, fishing, and joining wires. Time, 4 hours.
- XIII. An annunciator equipment for a private residence; installing instrument, devices, and battery; testing and connecting wires. Time, 3 hours.

NOTE.—In some problems two men may work together, thus reducing the time scheduled above.

7. SUGGESTIONS FOR CONDUCTING THE COURSE

The instructor conducting the course is urged to study carefully the lessons, installations, and jobs which compose the unit. He should bear in mind that construction principles or methods vary with local requirements. Large cities generally demand a higher standard of workmanship than small communities. What may be considered good work in a rural town or mining camp in a large city would be condemned as the work of a "salammoniac disturber." In conducting the course, ample latitude is allowed for the expression of the instructor's training and experience. It is most important that the aim be so to adjust these lessons to local conditions as to carry over to the student in the limited time a knowledge and skill of immediate practical use-value.

Lessons I, II, III, IV, V, and VI may be assigned to students as bedside occupations. They are, however, not designed for bedside work alone. Each student should take them as preliminary to the installation jobs.

The instructor will observe that each lesson and job is complete in itself, gives instructions for conducting the work, reference for study, questions for further study and a statement of the time required to complete it. The time is estimated upon the basis of experience in teaching young men whose education was that of the elementary school. Here, again, no hard and fast ruling is desired. The time may reasonably be taken to avoid the assignment of a task the length of which is greater than the time at the disposal of the students. This will eliminate lost time and waste in material.

The lessons and jobs lend themselves to individual instruction rather than class instruction. Class instruction is advantageous in matters of general interest applicable to the work. A "shop talk" may be created on the foundation of any question that may arise in the series of lessons. The duration of a shop talk varies with the topic. A short shop talk of from 5 to 10 minutes is more desirable than an extended one.

8. LIST OF BOOKS USED WITH LESSONS AND JOBS

Books should be provided to encourage the student to read and consult them frequently. Aside from the interest of the subject matter, the actual reading carries over the conviction that the work the student seeks to master will have a definite value in terms of money. From the books listed a number of sections may be selected for supplementary study.

Make a tactful and thorough study of the physical condition of student, his mental ability, his needs, aims, and purpose. Select for reading only the material which you know he is capable of digesting and actually needs to make good. Should a student show an inclination and ability for further study, assign more than the average book work, but in every case be sure the lessons and jobs are not shirked.

Timbie, W. H.: *Essentials of Electricity*. John Wiley & Sons, (Inc.), New York, 1914. \$1.25. (An exceptionally interesting and understandable description of the flow of electricity.)

Croft, Terrell: *Wiring of Finished Buildings*. McGraw-Hill Book Co. (Inc.), New York, 1915. \$2. (Although in these pages the reading recommended describes electric-light wiring, the methods followed, and tools used are the same as for bell and annunciator wiring.)

Croft, Terrell: *American Electricians' Handbook*. McGraw-Hill Book Co. (Inc.), New York, 1914. \$3. (Section 4 on interior wiring is so helpful to the student of modern building equipment that no study of electrical installation would be complete without the store of information and suggestions it contains.)

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets comprising Part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing the students' instruction sheets have not been printed separately as was originally intended, but have been included in the one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

LESSON I

The study of a manual-reset needle-drop annunciator

This annunciator was commonly used in residences, offices, and hotels 15 years ago, and is still widely used on small hotel elevator installations, railroad cars, and ships.

The parts and their functions are here described. Compare the instrument which you have with the drawing (Figure 1). Do not take this annunciator apart—its parts and their operation may be studied without disturbing their delicate adjustment.

Parts	Functions
The wood case-----	To hold and protect all parts so that they will work properly.
The ground plate of sheet metal--	To hold the electromagnet drop frames and convey the current from one side of the circuit to all drop electromagnets.
The drop frame-----	To hold the electromagnet, armature and spring, fly cam, fly cam shaft, and indicating needle compactly together for effective operation; also to support the manual reset rack.
The electromagnet-----	To provide a path for the electric current which creates the magnetic circuit.
The armature with spring-----	To hold the fly cam when indicating needle is in reset position and to release it for indication when attracted toward electromagnet while the current flows through its windings. The spring forces armature away from magnet when the current stops flowing.
The fly cam-----	To turn the indicating-needle shaft by gravity when released by armature and to reset needle when forced back by reset rack.
The needle shaft-----	To support the needle and fly cam.
The needle-----	To indicate by pointing.
The manual reset rack-----	To reset the needles by forcing the fly cams up to the armatures.
The lever spring-----	To force the reset rack downward.
The vibrating bell-----	To announce the indication of a call.
The terminal board-----	To hold the binding screws for the connection of internal and external wires.
The indicating plate-----	To contain the indications of numbers or names over the needles.
The face-----	A frame's glass light to cover the indicating plate and needles.
The lugs-----	To hold the screws for fastening annunciator to wall or other support.

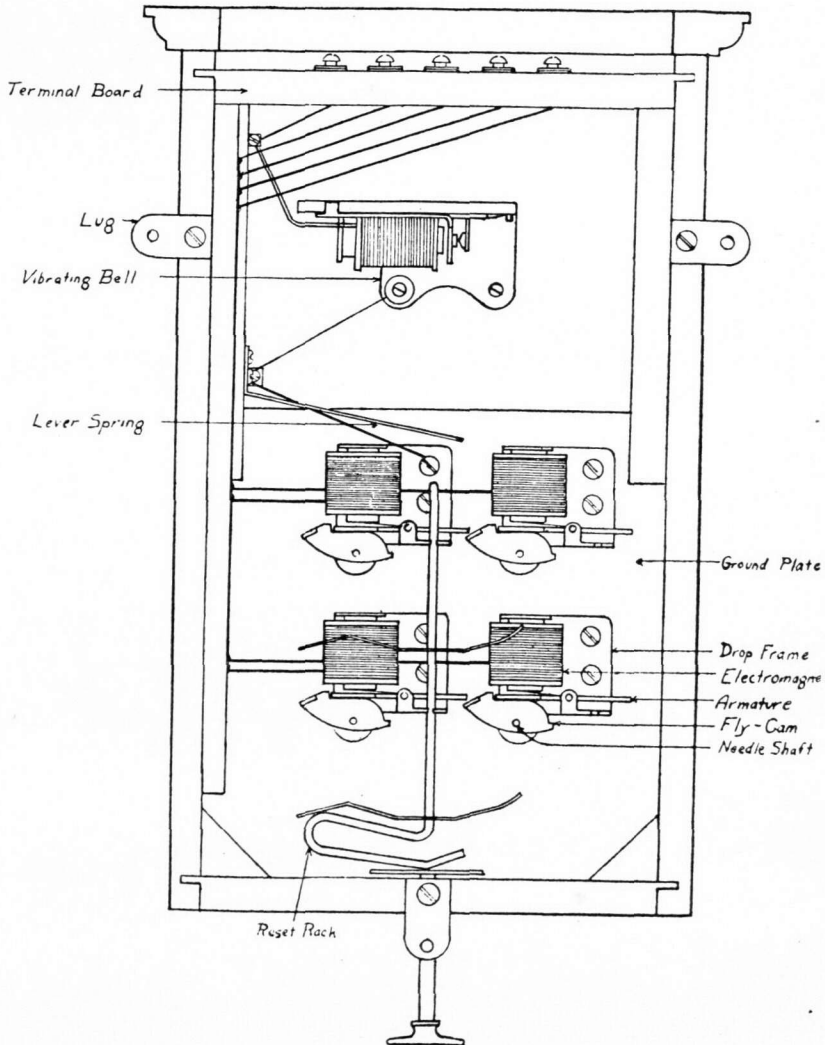
Learn to know these parts and their functions well enough to describe them without reference to the lesson sheet.

Before taking up your next lesson, it will be well for you to know a little about electricity. Ask for W. H. Timbie's "Essentials of Electricity." Read paragraphs 1 to 4, page 1, until you understand the flow of electricity. If you have had this lesson and the others in bell wiring, turn to page 19 and review the summary of your study.

This annunciator is manufactured by the Manhattan Electrical Supply Co., New York, N. Y.

Questions for further study

1. On what kind of installations is this annunciator still in use?
2. Trace out the internal wires to one drop, starting at binding screw on terminal board marked "B" back to any other binding screw on the board. Draw a rough sketch or diagram of the circuit.



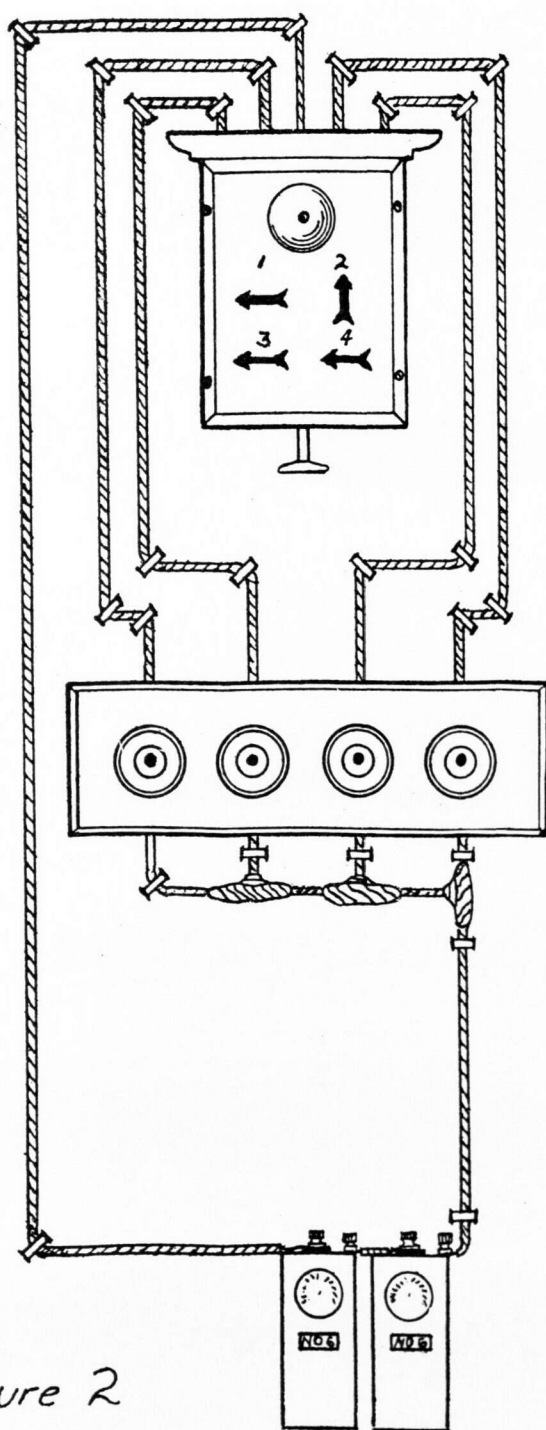
LESSON II

[An exercise in exposed work wiring for a manual reset needle drop annunciator with push buttons centrally located]

This lesson is arranged to give you experience in fastening wires with double-pointed tacks, called electrician's staples. The exposed wiring in finished houses is generally fastened to wood supports, such as door and window trim, base board, wainscot and picture molding, or any wood supports that will offer a path between outlets.

Tools and equipment

A drawing board 30 inches wide by 36 inches long, — feet of No. 18 annunciator wire, three dozen $\frac{3}{8}$ -inch square-top staples, twenty $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws, one manual reset four-point needle-drop annunciator, four wood push buttons, four cells of

*Figure 2*

dry battery, one round lead pencil, one $2\frac{1}{2}$ -inch Champion screw driver, one midget (Valley Pet) screw driver, one pair of 7-inch side-cutting pliers, one No. 13 bell-faced nail hammer, and one 5-foot zigzag rule.

How to do the work

First consult wiring diagram (figs. 2 and 3). Lay out your instrument, push buttons, and battery according to the diagram. The battery need not be fastened to the board. If more convenient, place it near where you are working. The wiring must be done first. Measure for the amount of wire you will need to do the job and fill amount in space above. Allow 12 inches surplus on each wire to be connected to binding screws of annunciator and 4 inches surplus on each wire to binding screws on push buttons. The surplus needed for connection to the battery depends upon where you will place it.

Before fastening the wire to the board be sure to straighten it by removing all kinks and twists. Beginning at a point where the binding screw on annunciator marked "B" will be when instrument is set, lay your wire after having measured 12 inches from end. Drive a staple over wire at this point. Drive staple over the wire just sufficient to hold it in place and not to injure the conductor or its insulation. Drive staple straight down over the wire. Avoid spreading or driving it sideways. Plan laying your wires so they will clear and not be under the instrument. Continue fastening wires as laid out in the diagram. Do not fail to leave the surplus required at binding screws of instrument and push buttons.

At the push buttons make the three taps off the button battery wire. Skin about 1 inch of insulation off ends of tap wires. Skin off about 1 inch of insulation from button battery wire at points beneath or beside the push buttons. Scrape the bared wire clean. Turn the ends of tap wires over the bared portions of button battery wire so that the result will look like the drawing of the "ordinary tap" described in Figure 102 on page 94 of Terrell Crofts' "American Electricians' Handbook." All joints or splices must be insulated with friction tape. Tear off from roll about 4 inches of tape; strip into halves down its length. Beginning at insulation of wire at one side of tap, turn the tape spirally under tension toward the other side and make turns overlap until the bare wire is well covered. The insulation of a tap prevents contact of conductor with surface wired over, contact with adjacent wires, and furnishes protection against corrosion.

Skin the insulation at least 1 inch from the ends of the surplus wires that you will connect to binding screws of annunciator and push buttons. Make a helix of each wire at annunciator by turning the surplus insulated wire around the lead pencil under tension and then remove the pencil. No helix is required at push buttons.

Set the annunciator fast to the board with the wood screws. Fasten the bared end of the wire which runs directly from the battery beneath the washer of binding screw marked "B." This wire is the bell-battery wire. The remaining wires are section wires. Fasten each in turn beneath the washer of one of the other binding screws. Turn the ends of all wires beneath binding screws in the direction that screw turns to tighten.

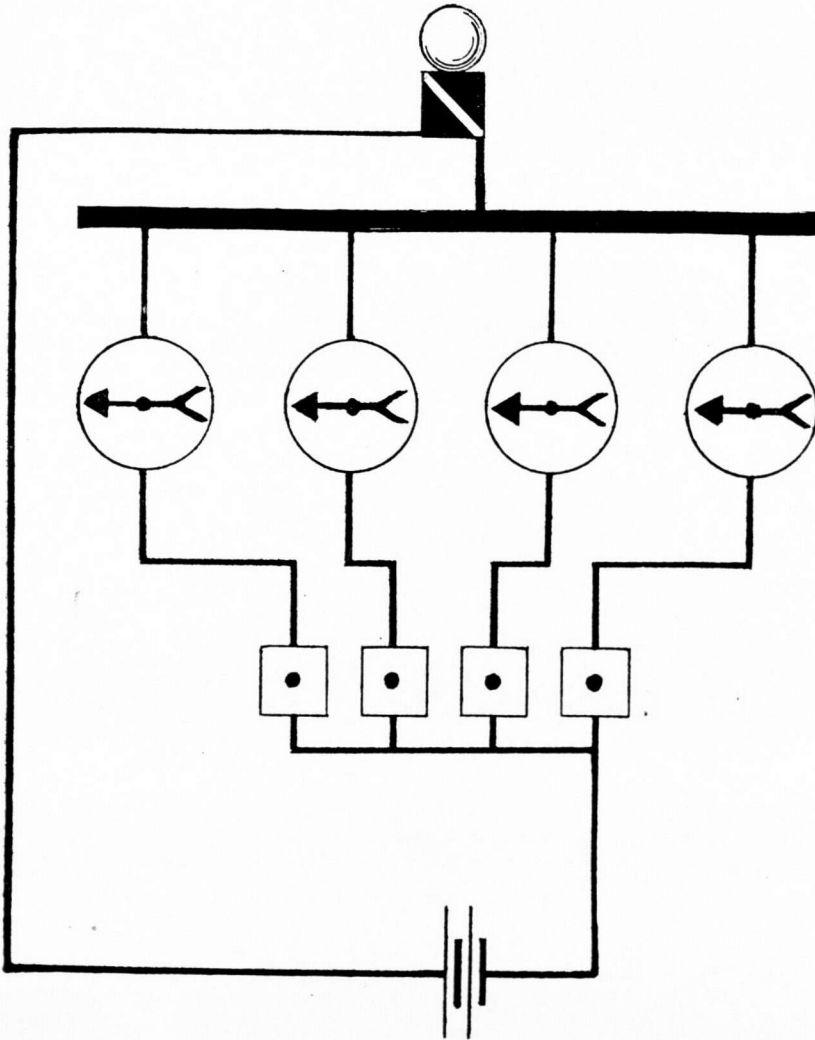
Remove the cap and button from each push button; thread the wires up through the holes in the base. Note the countersunk holes for screws fastening base to the board. Fasten the base to the board with flat-head wood screws. Shave more insulation from the wires if necessary and turn the bared ends under the heads of binding screws. Remember that they must be turned in the right direction. Cut off all surplus wire before driving down the binding screws.

The last thing to be done on a bell job is "hooking up" the battery. Connect the wires to the dry-battery binding posts. Press the push buttons separately and the bell should ring when the needle indicates.

An understanding of the power produced when the electric current flows through the electromagnet coils of the bell is valuable. Ask again for W. H. Timbie's "Essentials of Electricity" and turn to page 124; read paragraph 55 to bottom of page 126; then turn to and read paragraph 110 on page 228. If you have had this lesson, turn to page 20 of the same book and do problems 32, 33, and 35.

Questions for further study

1. What would you do if the bell on this annunciator failed to ring and a needle indicates correctly when the push button is pressed?
2. What must you avoid in driving staples over wire?

*Figure 3*

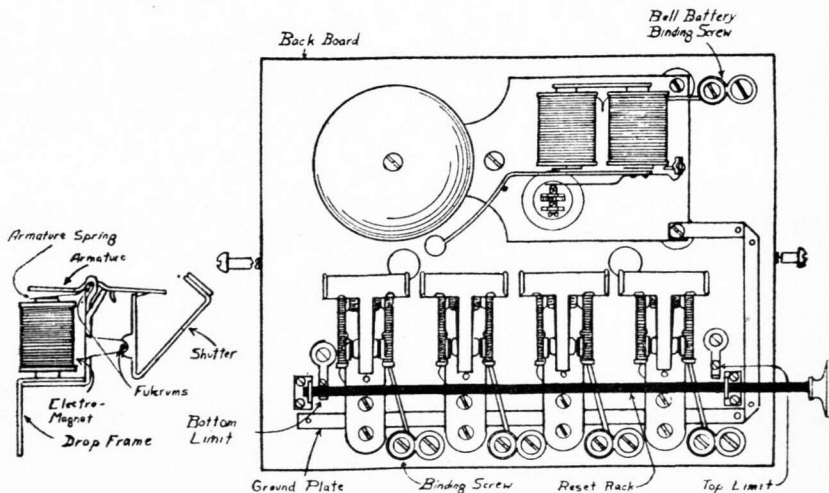
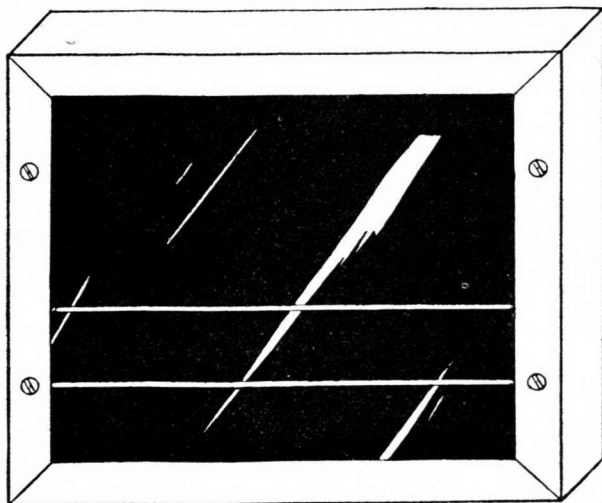
LESSON III

[The study of a manual-reset gravity-drop annunciator]

This annunciator is widely used in residences, offices, and hotels. It is more desirable than the needle-drop annunciator because the indications are more readily changed, the drops are more positive acting, and the internal parts are more easily inspected. The simple removal of the casing exposes all parts for inspection and repair. This type of instrument does not work well on elevators, railroad cars, or on ships.

The parts and their functions are here described. Compare the instrument which you have with the drawing (figs. 4 and 6). Do not take the instrument apart—the parts and their operation may be studied without disturbing their adjustment.

Parts	Functions
The backboard -----	To hold all working parts mounted on it compactly together.
The ground plate or strip of sheet copper.	To convey the current from one side of the circuit to all drop electromagnets.



The drop frame -----	To hold the electromagnet, armature and shutter fulcrums, armature and spring, and the drop shutter.
The electromagnet -----	To provide a path for the electric current which creates the magnetic circuit.
The double fulcrums -----	To hold armature and drop shutter on spindles.
The armature with spring -----	To hold the gravity-drop shutter in reset position and to release it for indication when attracted toward electromagnet while current flows through windings. The spring forces armature away from magnet when current stops flowing.

Parts	Functions
The gravity-drop shutter-----	To hold the indicating card exposed when dropped or concealed when reset.
The manual reset rack-----	To reset the drop shutters by raising them to engage with the armature.
The reset up and down limits----	To keep reset rack from being raised too high or dropped too low.
The vibrating bell-----	To announce the indication of a call.
The binding screws-----	To hold connected the internal and external wires.
The glass-faced case-----	To cover the working parts mounted on the backboard, exposing to view only the indications when dropped.

Learn to know the parts and their functions well enough to describe them without reference to the lesson sheet.

It will interest you to know just how the current that flows from the dry battery is produced. You will find this described in W. H. Timbie's "Essentials of Electricity," pages 194-196, paragraphs 89-91. If you have had that lesson, study how the electric current flows in a series circuit by turning to paragraphs 13-14, pages 23-25, of the same book.

This annunciator is manufactured by W. R. Ostrander & Co., New York, N. Y.

Questions for further study

1. On what kind of jobs should you avoid using this instrument?
2. Describe the difference between the way indications are made on this instrument and how they are made on the needle-drop annunciator.
3. What advantage does this instrument possess over the needle-drop type?

LESSON IV

[An exercise in exposed work wiring for a manual reset gravity-drop annunciator, with push buttons located at separated points]

This lesson is arranged to give you experience in fastening wires with electricians' staples. The lesson is also designed to show that an annunciator may be operated by push buttons set in different parts of a building, unlike the problem in Lesson 2, in which the push buttons are set in one location.

Tools and equipment

A drawing board 30 inches wide by 36 inches long, — feet of No. 18 annunciator wire, three dozen $\frac{3}{8}$ -inch square top staples, twenty $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws, two $1\frac{1}{2}$ -inch No. 8 flat-head bright wood screws, one manual-reset four-drop gravity annunciator, four wood push buttons, four cells of dry battery, one round lead pencil, one $2\frac{1}{2}$ -inch Champion screw driver, one midget (Valley Pet) screw driver, one pair of 7-inch side-cutting pliers, one No. 13 bell-faced nail hammer, and one 5-foot zigzag rule.

How to do the work

First consult wiring diagram (figs. 5 and 6). Lay out your instrument, push buttons, and battery according to the diagram. The battery need not be fastened to the board. If more convenient, place it near where you are working. The wiring must be done first. Measure for the amount of wire you will need to do the job and fill amount in space above. Allow 12 inches surplus on each wire to be connected to binding screws of annunciator and 4 inches surplus on each wire to binding screws on push buttons. The surplus needed for connection to the battery depends upon where you will place it.

Examine the backboard of the annunciator and you will find two large holes bored through it about one-third the length from either side and halfway between top and bottom. These holes are for the entrance of wires to the binding screws. Arrange your wires so that two section wires will enter through hole at right and two section wires and bell-battery wire will enter through hole at left. This will bring the bell-battery wire near binding screw connected with the bell. Before fastening the wire to the board, be sure to straighten it by removing all kinks and twists. In this case you will have to lay wires beneath the backboard of the annunciator. In doing so be careful to avoid driving screws into wire when fastening the instrument. In every other regard fasten your wires to the board with staples as you did in Lesson II.

At the push buttons make the taps off the button battery wire and cover them with friction tape as you did in Lesson II. You are now ready to screw the annunciator back-

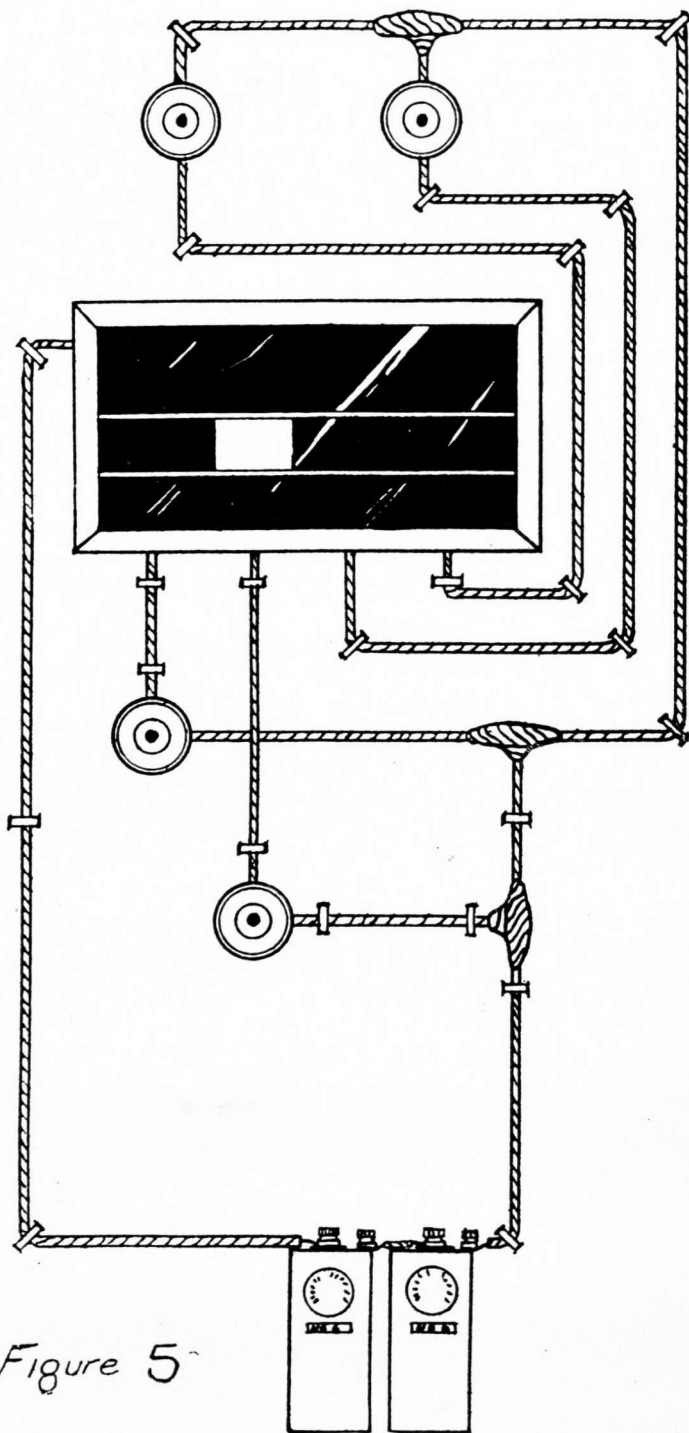


Figure 5

board to the work board. First draw the wires through the holes described above. Since no helices are used when binding screws are concealed, be sure that wires are long enough for connection to each binding screw. Then fasten backboard to work board with the $1\frac{1}{2}$ -inch screws. Next skin the insulation off ends of all wires and fasten them under heads of binding screws, the bell battery wire so binding post of bell and section wires to respective drop binding screws. Fail not to turn the wires in the right direction. If you wish, you may write indicator cards as follows and place them on drop shutters: "Basement entrance," "Front entrance," "Pantry," "Housekeeper." The two lower push buttons might be con-

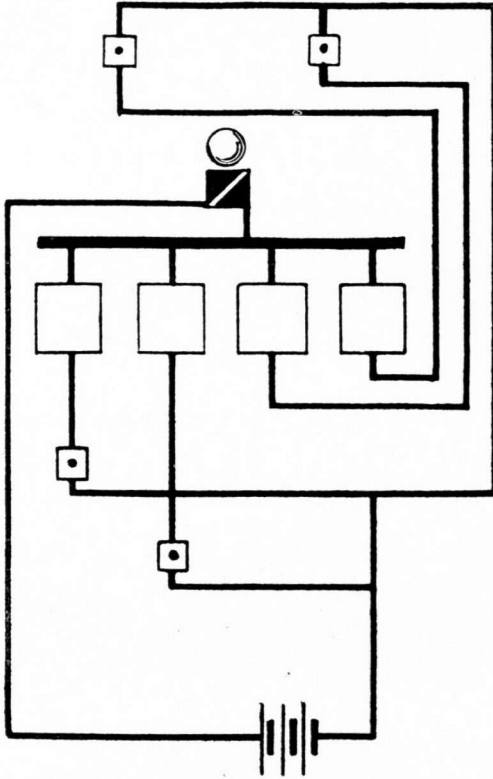


Figure 6

sidered entrance push buttons and the upper two the pantry and housekeeper's room. Each push button when pressed must cause the proper drop to appear on annunciator.

Draw wires through bases of push buttons as you did in the second lesson and connect them after having fastened bases to the work board. Connect your battery just as you did before and try each drop separately a number of times. Take off the case of the instrument and while pressing push buttons take note of how the drops operate.

A description of the different kinds of bells that may be used in conjunction with annunciators will be found in W. H. Timbie's *Essentials of Electricity*; beginning on page 227 study paragraphs 109-114. Learn to know them and just how they work. If you did so in a former lesson, just review it and pass on to paragraph 15, pages 25-26, and study how the resistance in a series circuit affects the flow of current.

Questions for further study

1. Why did you not make helices on the wires running to annunciator binding screws?
2. In what way does this annunciator exercise differ from the exercise in Lesson II?
3. When one person wishes to call a number of persons to him, can he do it electrically without an annunciator? Make a statement describing how this can be done.
4. If a number of persons wish to call one person to them, can they do it electrically without an annunciator? State how.

LESSON V

[The study of a semaphore-lock gravity-drop annunciator equipped for individual electrical resetting]

The annunciator here described is widely used in residences, offices, hotels, industrial plants, elevators, railroad cars, and ships where a highly efficient instrument is demanded. The drops are positively locked in position so they can not be shaken down by jars or vibration. The semaphore drops lock in both indicating and restored positions and can be operated only by means of push buttons. The electrical reset push buttons may be located on the annunciator case or at any remote point.

The parts and their functions are here described. Compare the instrument with the drawings (Figs. 7 and 9). Do not attempt to take this annunciator apart; its parts and their operation may be studied without disturbing their exceptionally delicate adjustment.

Parts	Functions
The backboard.....	To hold complete mechanism, operating parts, connector plates, and bell contact springs, excepting the vibrating bell.
The wood case with glass face....	To contain the bell, bell contact springs, and to cover the working parts mounted on the backboard, exposing to view only the indications when dropped.
The fulcrum frame.....	To hold compactly for operation the setting and restoring electromagnets, armature with rocker arm, locking shutter, and the reset contact spring.
The setting electromagnet.....	To provide a path for the current which creates the magnetic circuit for drawing the armature down so as to force locking shutter into indicating position.
The reset electromagnet.....	To provide a path for the current which creates the magnetic circuit for drawing the armature down so as to force locking shutter into restoring position.
The armature with rocker arm....	To mechanically swing the locking shutter into either position and lock it.
The locking shutter.....	To carry the indicating cards and be mechanically swung into exposed or concealed positions and locked.
The reset contact spring.....	To convey the current from reset electromagnet through shutter to the reset ground strip when locking shutter is in exposed position.
The reset ground strip.....	To join all the fulcrum frames of drops together so current may be conveyed for resetting the shutters.
The connector plates.....	To connect the external wires of a system to the internal wires of the instrument. There are seven on this instrument—one reset button connector, four call button connectors, and two battery connectors.

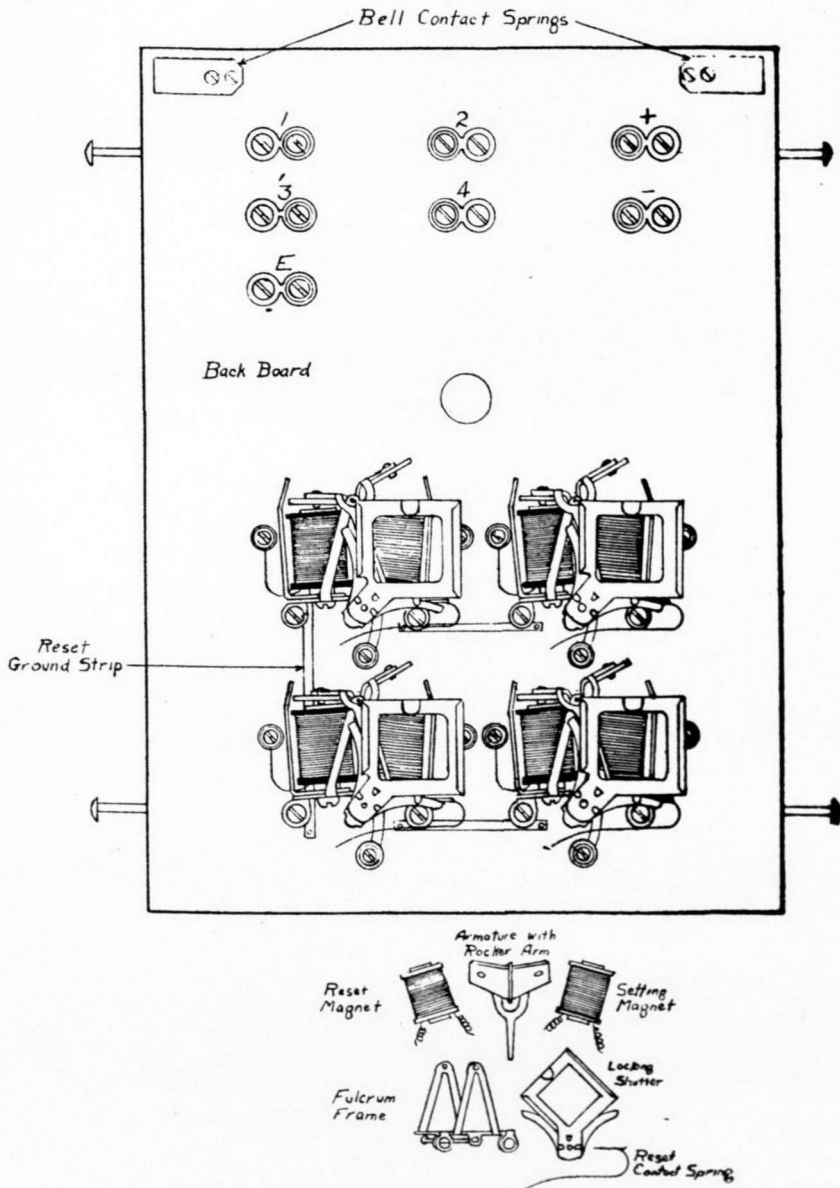
Learn to know the parts and their functions well enough to describe them without reference to the lesson sheet.

Continue the study of the flow of electricity in W. H. Timbie's *Essentials of Electricity*. Beginning with paragraph 5, merely note the symbols and become familiar with the polarity of the electric current. Read on through paragraph 6 and try some of the examples and problems, all on page 6. Should you have completed this study in a former lesson, turn to pages 26-27 of the same book and study paragraph 16 to learn just how the voltage effects the flow of current in a series circuit.

This annunciator is manufactured by Edwards & Co., New York, N. Y.

Questions for further study

1. What is a semaphore and where is it used?
2. What advantages are claimed for this type of instrument?
3. Why is electrical resetting an advantage?

*Drop Unassembled*

4. Would you recommend that this type of instrument be installed in a forge shop? Why?
5. What kind of a sound-producing device would have to replace the bell if used in a forge shop?

LESSON VI

[An exercise in exposed-work wiring for two-semicolon lock gravity-drop annunciators equipped for individual electrical resetting and operated by push buttons centrally located]

This lesson is arranged to give you experience in fastening wires with electricians' staples. The lesson is also designed to show that two annunciators may be operated independently or in multiple by push buttons located at one point, that a simple wiring system may be provided which will not lead to the complications usually encountered when annunciators are connected in multiple. The lesson will also provide a means of demonstrating the use of a type of annunciator used in modern equipment and a more convenient way of resetting the drops than the manual or hand reset.

Tools and equipment

A drawing board of $\frac{7}{8}$ -inch white pine 30 inches wide by 36 inches long, — feet of No. 18 annunciator wire, six dozen $\frac{3}{8}$ -inch square-top staples, thirty $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws, six $1\frac{1}{2}$ -inch No. 8 flat-head bright wood screws, two 4-drop semaphore-lock gravity-drop annunciators, 10 wood push buttons, four cells of dry battery, one round lead pencil, one $2\frac{1}{2}$ -inch Champion screw driver, one midget (Valley Pet) screw driver, one pair of 7-inch side-cutting pliers, one No. 13 bell-faced nail hammer, one 5-foot zigzag rule and one roll of $\frac{3}{4}$ -inch friction tape.

How to do the work

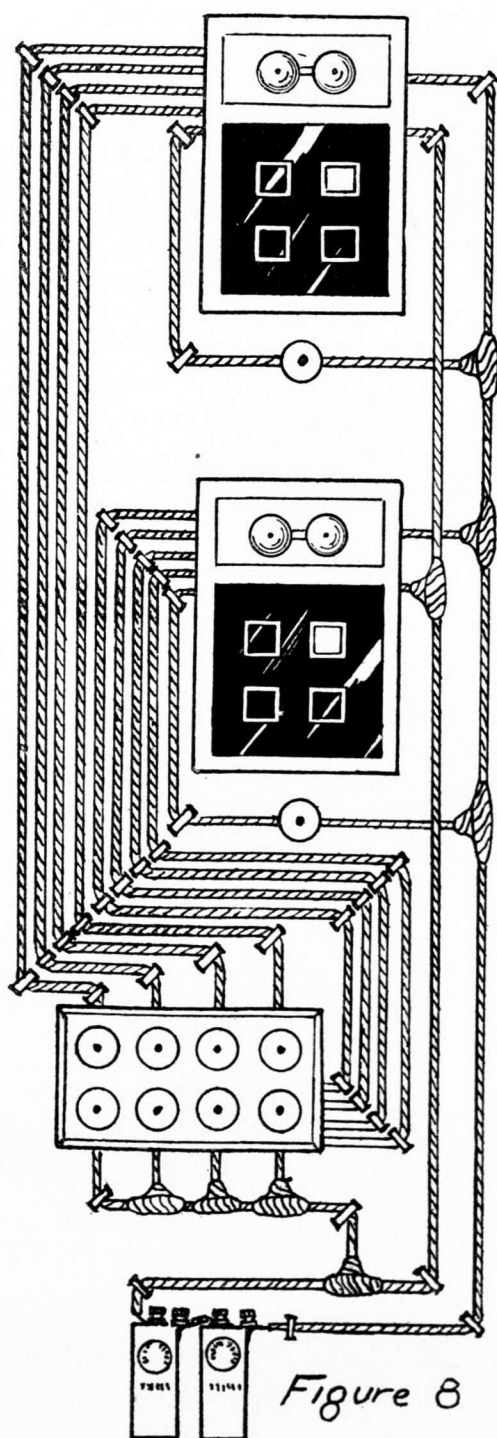
First consult wiring diagrams (figs. 8 and 9). Lay out your instruments, push buttons, and battery according to the diagrams. The battery need not be fastened to the work board. If more convenient, place it near where you are working. The wiring must be done first. Measure for the amount of wire you will need to do the job. Allow 12 inches surplus on each wire to be connected to binding screws on the connector plates of the annunciators and 4 inches surplus on each wire to binding screws on push buttons. The surplus needed for connection to the battery depends upon where you place it. Fill amount in the space left for it above.

Examine the backboard of each annunciator and you will find a large hole bored through it just below or above the connector plates. If you find there is no hole, bore one. This hole is for the entrance of wires to the binding screws on connector plates. Before fastening wires to the work board be sure to straighten it by removing all kinks and twists. In this case you will have to lay the wires beneath the backboard of annunciators. Fasten your wires to the work board as you did in the previous lessons.

At the push buttons make the taps off the battery wires and cover them with friction tape as you did in Lesson III. You are now ready to fasten the annunciator's backboards to the work board. First draw the wires through the holes described above. Since no helices are used when binding screws are concealed, be sure that the wires are long enough for connection to each binding screw. Now fasten the backboards to the work boards with the $1\frac{1}{2}$ -inch screws. Avoid driving the screws into the wire when fastening instrument. Next skin the insulation off ends of all wires and fasten them under the heads of binding screws on connector plates, the battery wires to the battery connectors, the sections wires to the call-button connectors, and the sections wires from reset push buttons to the reset button connectors. Fail not to turn the wires in the right direction.

Draw wires through bases of push buttons as you did in the third lesson and connect them after having fastened bases to the work board. If you desire, you may cut and finish a block of $\frac{7}{8}$ -inch white pine large enough for a mat to hold the eight push buttons grouped together and fasten this mat to the work board. Connect your battery just as you did before and try each drop separately a number of times. Take off the cases of the instruments. Bridge a wire across tops of backboards, so as to connect the two bell contact springs, otherwise the drops will not operate. Finally press all of the push buttons and observe how the drops operate.

If you wish, you may write indicator cards as follows: "Jones," "Raymond," "Smith," and "Brown," two of each, and place them on the drop shutters. The lower row of grouped push buttons are designed to operate the drops on the lower annunciator, the upper row to

*Figure 8*

operate drops with similar names on upper annunciator. Each push button when pressed must cause the proper drop to appear. Press the reset push buttons and restore all drops. Then press each pair of vertically arranged push buttons together and a drop containing the same name is exposed on each annunciator.

In order to avoid the complications that arise when two drops are connected in multiple to be operated by only one push button, obtain a copy of Terrell Croft's "American Electricians' Handbook" and turn to paragraph 288 on page 536. Read the second section of that paragraph through to end on page 537. Study the diagrams referred to in that section, which you will find on page 535. They will teach you to avoid the multiple connection of annunciators.

Questions for further study

1. Where could you use a system such as this to advantage?
2. What did you observe in the action of the drops when the case was removed and push buttons pressed? Did the drops act more slowly or quicker than when the case covered the mechanism?
3. Is it good practice to connect annunciators in multiple?

LESSON VII

[Installation 1.—An annunciator equipment for a small business office—Job 1]

Locate outlets for the annunciator, push buttons, and the battery.

Tools and equipment

One soft lead pencil, a zigzag rule 5 feet long, and a spreading stepladder 5 feet tall.

How to do the work

First consult wiring diagram (fig. 3).

Locate the annunciator outlet on an office partition or wall in the general office near enough for the indications to be readily seen by the office employees it is designed to attract. Fix the location by marking with a lead pencil. Place the mark from 6 feet to 6 feet 6 inches above the finished floor. Avoid placing it near a door or on any support subject to severe jars or vibration. Avoid locating the outlet over washbasins or steam radiators. The needle-drop annunciator to be used on this installation is easily affected by jars or constant vibration, and its metal parts are subject to corrosion caused by moisture.

Locate the push button outlets, or, as in this case, outlet for push buttons, by placing a mark 4 feet above the finished floor on a wall or office partition beside the employer's desk within convenient reaching distance when he is seated.

Locate the battery outlet in a cool, dry place, preferably a clothes locker or in the cellar, near the annunciator outlet.

Before setting out to do the next job be sure to examine the walls and tops of office partitions and partition pilasters. Look for picture molding, door and window trim, baseboard, and wainscot. Examine all of these for a possible means of support or runway for wires between the outlets. Also observe the finish of the trim and office partitions, the color of wall paper or decoration, so that you may select wire with insulation of a color to match. Avoid color contrasts that will tend to attract attention to the wires.

Questions for further study

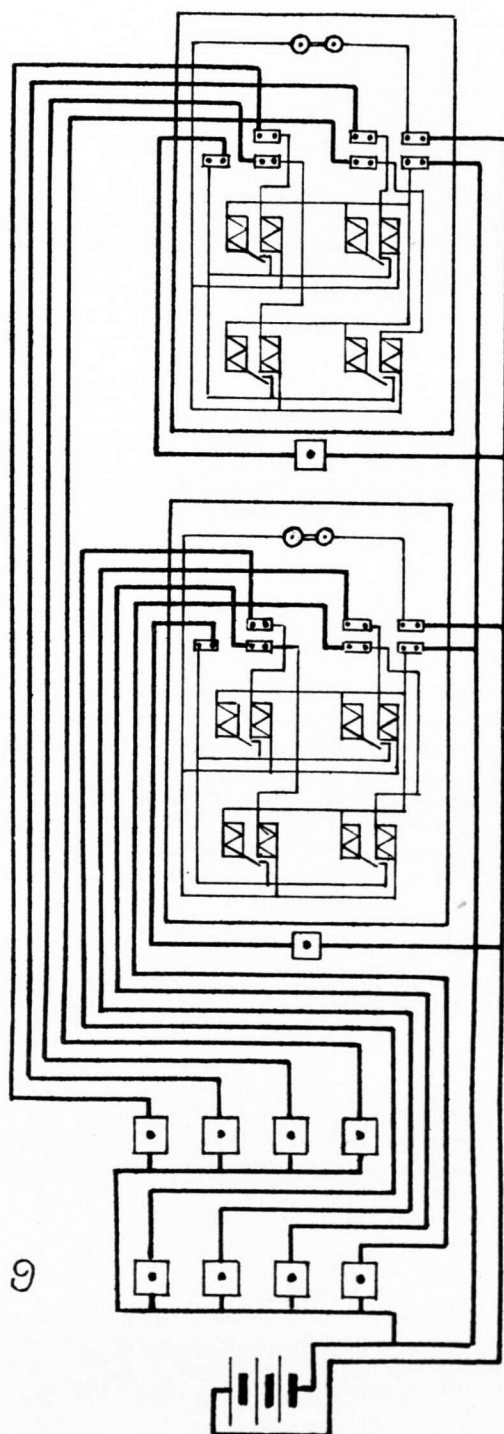
1. Why is it necessary to avoid locating annunciator outlet near a door?
2. Why should you avoid locating annunciator outlet over a washbasin?
3. What distance from the floor should annunciator outlet be located?

LESSON VIII

[Installation 1.—An annunciator equipment for a small business office—Job 2]

Install the wires between outlets according to the exposed-work method of wiring.

The method of installing wires depends upon the kind of building and its condition when an electrical equipment is contemplated. A general idea as to wiring methods will be found

*Figure 9*

in Terrell Croft's "Wiring of Finished Buildings." Paragraphs 113-114 on page 101 should be read. Although the book describes only electric-light wiring, the methods and tools are the same as for bell wiring. If you have had the above in a previous lesson, it will be to your advantage to become familiar with the different kinds of fasteners used in exposed-work wiring that are described in Terrell Croft's "American Electricians' Handbook," paragraph 272-274, on pages 528-529.

Tools and equipment

One soft lead pencil, one 5-foot zigzag rule, one 5-foot spreading ladder, one pair of 7-inch side-cutting pliers, one 2½-inch Champion screw driver, one No. 13 bell-faced nail hammer, one ratchet brace, one ⅜-inch bell hangers' bit 18 inches long, — feet No. 18 annunciator wire in the following colors:

2 ounces ⅜-inch square-top staples, 25 No. 6 Blake insulated staples, one roll of ¾-inch black or white friction tape.

How to do the work

First consult wiring diagram (fig. 3). Measure for the amount of wire needed to make the runs from outlet to outlet. Run five wires—one button battery wire and four section wires—from annunciator outlet to the outlet for push buttons. Allow 12 inches surplus on each wire at both outlets. Run two wires—a bell battery wire and a button battery wire—from the annunciator outlet to the battery outlet. Allow 12 inches surplus on each wire at both outlets. Decide what colors you need and the amount of each. Fill amounts and colors in blank spaces above. Study the conditions on this job and find out what other tools you will need. Use blank spaces above to order these extra tools. Obtain all tools and materials.

Where the tops of office partitions provide a convenient and more or less concealed runway for wires use them. If not, use door and window trim, picture molding, baseboard, and wainscot. With brace and proper sized auger or electrician's bit bore such holes as you find necessary to make a clear runway for wiring between outlets. Proceed to other points, and should you find it necessary to run wires through a lath and plaster or similar permanent partition into another room, bore holes through such partition at some point over door trim or at junction of baseboard and door trim.

Bunch together the five wires to be run from the annunciator outlet to the outlet for push buttons, so as to form a cable. Tape them together with a few inches of friction tape at points 4 feet apart along its length and at ends. Wires that are to be run along baseboard, trim, and wainscot, and wires from top of office partition to outlets for annunciator and push buttons should be covered with friction tape. Where possible plan to run wires up or down alongside of partition pilasters leading to outlets. Keep the wires concealed as much as possible.

Next lay out the cabled wires loosely from outlet to outlet. Then, starting at either outlet, leaving 12 inches of surplus wires at outlet from which you begin, work toward the other outlet, fastening the cabled wires to the wood supports with Blake saddle-back staples. Use the saddle-back staples where the five wires are bound together with tape. Use plain staples only where necessary to fasten single wires. Drive the staples over wire just sufficiently to hold them in place and not to injure the conductor or its insulation. Drive them straight down over the wire and avoid spreading or driving them sideways. Two wires should not be fastened under one plain staple in order to avoid creating a short circuit. When using plain staples stagger them so that they will not touch each other, because such staples in contact cutting through insulation also cause short circuits.

If you find it necessary to lengthen a wire, skin about 1 inch of insulation off ends of wires to be joined. Scrape the wire ends clean, cross the ends, and turn them over each other so that the result will look like the drawing of the "Splice in single wire" described in Figure 101 on page 93 of Terrell Croft's "American Electricians' Handbook." All joints or splices must be insulated with friction tape. Tear off from roll about 4 inches of tape, strip into halves down its length. Beginning at insulation of wire on one side of joint turn

the tape spirally under tension toward the other side and make the turns overlap until the bare wire is well covered. The insulation of a joint or splice prevents contact of conductor with surface wired over, contact with adjacent wires, and furnishes protection against corrosion.

Continue fastening the cabled wires in place until they are installed. Then just as carefully and neatly run the pair of wires from the battery outlet to the annunciator outlet, using the nearest wooden support for a runway. Tape the wires together over entire length. Leave 12 inches of surplus wire at each outlet. Prepare the wires at outlets for connection to instrument, devices, and battery that will be installed as described in the next lesson.

Questions for further study

1. Name the wires running from the annunciator outlet to the outlet for push buttons.
2. Why should plain staples be staggered when fastening single wires?
3. Why is it necessary to insulate a running joint or splice?
4. Name the wires running from the battery outlet to the annunciator outlet.

LESSON IX

[Installation 1.—An annunciator equipment for a small business office—Job 3]

Test and identify the wires in the equipment.

The wires you have just installed may be ready for connection. It is good practice to be sure that they are; therefore, test them.

Before proceeding with this job an understanding of the pressure back of the current in electricity will prove useful. A description of this factor in the flow of electricity will be found in W. H. Timbie's "Essentials of Electricity," paragraphs 7-9, pages 11-16. If you have had this study, learn to know some of the methods employed by practical electricians in testing low-voltage circuits. Terrell Croft's "American Electricians' Handbook" describes these methods in paragraphs 91-96 on pages 38-40.

Tools and equipment

One 5-foot spreading stepladder, one 2½-inch Champion screw driver, one pair of 7-inch side-cutting pliers, one single-blade jackknife, one lead pencil, one roll ¾-inch friction tape, one electric-bell-testing outfit as described in Terrell Croft's "American Electricians' Handbook," paragraph 96 on page 40.

How to do the work

Skin 1 inch of insulation from the ends of all wires at outlets. Find out if the testing outfit is in good working order by touching the bared ends of wires together. If the bell rings, the outfit is O. K.

Connect the bared ends of testing outfit wires to bared ends of the two wires at battery outlet. Now go to the annunciator outlet and touch together the bared ends of the two wires that are run from the battery outlet. If the wires are not broken, the bell will ring. If the bell fails to ring, find the broken wire and repair it.

At annunciator outlet select one wire out of the five cabled wires that run to the outlet for push buttons. Connect one of the testing outfit wires to the bared end of the wire thus selected. Gather the four remaining wires together and tie around bared ends of all the bared ends of other testing outfit wire. Now go to the outlet for push buttons. Touch the bared ends of the five wires together. The bell should ring. Separate these wires one by one until the bell stops ringing. You will find that the last wire you separated is the single wire to which one wire of the testing outfit at annunciator outlet is connected. Fasten a piece of friction tape around it for identification. Again touch this wire to each of the other wires. If the bell rings each time, the taped wire is the button battery wire.

Go back to the annunciator outlet. First disconnect the single wire of cabled wires from the wire of testing outfit; then join or splice the single wire to one of the two wires running to the battery outlet. This wire—the button battery wire—is now running continuous from battery outlet to the outlet for push buttons. The remaining wire from the battery outlet to the annunciator outlet is the bell battery wire. The other four wires emerging at the annunciator outlet are the section wires.

It is good practice for two men to work on a testing job. Each should be stationed at an outlet from which the wires being tested emerge.

Questions for further study

1. Briefly describe the outfit you used for testing.
2. Describe another type of testing outfit, using dry-cell battery current.
3. Name the wires now exposed at the annunciator outlet.
4. What would you do if one of the section wires when connected to button battery wire failed to make the testing bell ring?

LESSON X

[Installation 1.—An annunciator equipment for a small business office—Job 4]

Set and connect the annunciator, push buttons, and battery.

W. H. Timbie's "Essentials of Electricity," paragraphs 10-12, pages 15-18, describe the resistance offered to the flow of the electric current. Try some of the examples and problems. If you have already studied this factor, go forward to paragraph 20, on pages 35-36, and become familiar with the flow of current in a parallel circuit. After you have finished this study, go on with your job.

Tools and equipment

One four-point needle-drop annunciator. (This instrument may be provided with indications, lettered above respective needles, on its face the figures "1, 2, 3, 4," or the names of four employees whom the instrument is designed to call, or the occupations of such persons—for example, "Boy," "Bookkeeper," "Stenographer," or "Cashier.")

Four wood push buttons, four cells of No. 6 dry battery-----

How to do the work

If the annunciator or push buttons are to be set on an outside wall or permanent partition, you should know if these are made up of wood lath and plaster, metal lath and plaster, solid brick, or hollow tile and plaster. Read on through and order the screws, lead sleeves, toggle bolts, and wood blocks you will need in addition to the tools and equipment above described.

If of wood lath and plaster, at annunciator outlet set back of annunciator against face of wall, mark places where screws will enter wall for holding, puncture plaster at marks with a thin wire nail or brad nail until lath are reached for holding all screws. Be sure the instrument will set plumb; then fasten it firmly to the wall with $1\frac{1}{2}$ -inch No. 5 flat-head bright wood screws. If the wall is of solid brick or hollow tile and plaster, mark for screws as described above with $\frac{5}{16}$ -inch star drill and hammer drill holes into brick 1 inch above or below markings for screws; plug the holes with wood plugs or lead sleeves $\frac{5}{16}$ -inch in diameter. If the star drill punctures the hollow portion of the tile, insert toggle bolts. Next provide two wooden cleats $\frac{7}{8}$ by $1\frac{1}{2}$ inch, long enough for fastening the instrument. Fasten these cleats to the wall with $1\frac{1}{2}$ -inch No. 5 flat-head bright wood screws or toggle bolts. If the wall is of metal lath and plaster, follow the method last described. Be careful that the markings for mounting the wood cleats do not coincide with those for mounting the instrument.

Fasten the annunciator to the wood cleats with $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws. Skin the insulation from the ends of all wires at outlet. Form a helix of the insulated portion of each wire. Select the bell-battery wire and fasten its bared end under the binding screw marked "B" or to unconnected binding post of the annunciator bell. Fasten the remaining section wires beneath the other binding screws. Do not overlook the need for turning the bared ends of wires in the proper direction when fastening to binding screws and binding posts.

Now go to the outlet for push buttons. Cut a block of $\frac{7}{8}$ -inch softwood 4 inches wide by 10 inches long for a mat on which to mount the push buttons. Stain and varnish that mat to match trim. Gouge out the back of the mat with an auger bit and wood-cutting chisel so as

to provide for the distribution of wires to each push button. Provide for fastening the mat to the wall or partition in the same manner as for the annunciator, except that screws or bolts used to support the mat should be placed so as to remain concealed when the push buttons are mounted. Splice the bared ends of four pieces of insulated wire 12 inches long to the button battery wire. You now have a button battery wire and a section wire for each push button. Be sure to tape the splice. Fasten the bases of push buttons to the mat with $\frac{3}{4}$ -inch No. 5 flat-head bright wood screws. The base must line up neatly. With a brace and $\frac{1}{8}$ -inch drill bit bore holes through push-button bases and mat so that the wires may be brought to the binding screws. After all these holes are bored remove any base that will prevent fastening mat to wall. Carefully select a button battery wire and a section wire and thread them through holes in mat and push-button bases. When all the wires are threaded through, fold wires that remain back of mat neatly into gouged out portion and fasten mat to wall. Replace any push-button base you may have removed in order to fasten mat to wall. Skin insulation from wires and fasten bared ends firmly under the binding screws. Always turn wires beneath binding screws in the direction that screw turns to tighten.

The installation of battery cells is always left to be done last. Cut three pieces of wire 12 inches each in length. Skin the insulation off ends of each. Form each length into a helix. Join the four cells into a series combination by fastening one end of a heliced wire to the carbon (+) binding post of one cell and the other end to the zinc (−) binding post of the second cell; one end of a second heliced wire to the carbon binding post of the second cell and the other end to the zinc binding post of third cell; one end of a third heliced wire to the carbon binding post of third cell and the other end to the zinc binding post of fourth cell. You now have two unconnected binding posts, one carbon and the other zinc. Provide a box for the cells or bind them together with twine. Place the cells close to battery outlet and after skinning insulation off the ends of the wires that emerge connect each one to an unconnected binding post of the battery. Fail not to turn wires around binding posts in the proper direction.

Proceed to the push buttons and pressing each in turn test the needle drops several times to assure yourself that they work.

Questions for further study

1. Would it be easy to change the titles over each needle drop on the annunciator you just installed? Give reason.
2. How would you fasten the annunciator to an office partition?
3. Where would you expect to find the "trouble" if the annunciator bell rang continually and one drop could not be reset?

LESSON XI

Installation 2.—An annunciator equipment for a private residence—Job 1

Locate outlets for the annunciator, push buttons, and the battery.

A finished residence is to be wired for the annunciator equipment with all wires concealed except where they emerge at outlets and in the cellar, where appearance does not figure, and it is desirable to have wires exposed for ready access when necessary. The wires are to be concealed without conduit.

The competent electrical worker must have a knowledge of the construction of buildings. Terrell Croft's book on "Wiring of Finished Buildings," paragraphs 197 to 199a, inclusive, pages 150–153, give a very good description of wooden-frame buildings. Paragraphs 204–207z, pages 157–159, describe how the work in finished building may be done neatly. Study these paragraphs, and when finished proceed to lay out your work.

Tools and equipment

One 5-foot spreading stepladder, one $\frac{1}{2}$ -inch electricians' bit 18 inches long, one ratchet brace, one No. 13 bell-faced nail hammer, one pair of 7-inch side-cutting pliers, one soft lead pencil, one 2½-inch Champion screw driver, one $\frac{1}{8}$ -inch auger bit, one extension bit holder, one 5-foot zigzag rule.

How to do the work

First consult wiring diagram 6.

Locate the annunciator outlet in the kitchen, usually on the first or ground floor, on an outside wall or permanent partition, near enough to be readily seen by the servants. Fix the location by marking with a lead pencil. Place the mark from 6 feet to 6 feet 6 inches above the finished floor. Avoid placing it near a door or on any support subject to vibration or severe jars. Avoid locating the outlet over washbasins, tubs, hot-water heaters, ranges, steam radiators, or near steam-heating pipes. The gravity-drop annunciator to be used on this installation is affected by severe jars, constant vibrations, and its metal parts are subject to corrosion caused by moisture, and the wood case may be affected by excessive differences in temperature.

Locate the push-button outlets as follows: One at front entrance, one at rear entrance, one in the pantry, and one in the housekeeper's room. At each place, if possible, locate the mark for push-button outlet on the knob side of a doorcasing 4 feet from the finished floor. If this is not desirable, find a wall or partition location that is desirable, with hammer tap lightly on the wall. If the sound of tapping is hollow, your mark is between studs; if the sound is dull, your mark is over a stud. Continue tapping from side to side until the hollow sound is produced. With brace and electrician's bit bore a hole through lath and plaster between studs. Repeat operation in the pantry. The outlets outside of front and rear entrances should be located 4 feet above the landing on the door-knob side of the jamb of doorcasing. The doorcasing is generally hollow. Bore holes through jambs with brace and $\frac{19}{16}$ -inch auger bit until hollow of casing is reached.

Locate the outlet for the battery in the basement on a shelf in a cool, dry place. Be sure to place the shelf farthest from the heating apparatus.

Questions for further study

1. Name the different kinds of annunciators.
2. What size of wire should be used on this job?
3. What is an outlet?
4. Describe how you would insulate a joint or splice.
5. In Lesson 10 the push buttons are mounted on a mat fastened to the wall. How could you provide for placing the push buttons on a sanitary type of desk likely to be moved from time to time?

LESSON XII

[An annunciator equipment for a private residence—Job 2]

Providing unobstructed runways between outlets, fishing, and joining wires.

Illustrated descriptions of how this work may be done will be found in Terrell Croft's "Wiring of Finished Buildings." Paragraphs 208–218, pages 159–168, describe the removal of floor boards and cutting of pockets; paragraphs 219–226, pages 168–170, describe the removal and replacement of trim and baseboards and cutting into plastered surfaces. Make a thorough study of this subject. Work in finished buildings must be so carefully done that after you have finished there should be no trace of your efforts to conceal the wiring.

Tools and equipment

One 5-foot spreading stepladder, one pair of 7-inch side-cutting pliers, one No. 13 bell-faced nail hammer, one $2\frac{1}{2}$ -inch Champion screw driver, one 5-foot zigzag rule, one $\frac{5}{16}$ -inch auger bit, one extension bit holder, one ratchet brace, one $\frac{3}{32}$ -inch electrician's bit 18 inches long, one 12-inch compass saw, one 1-inch wood-cutting chisel, one single-blade jackknife, one soft lead pencil, one 50-foot $\frac{1}{8}$ steel (snake) fishing wire, one roll $\frac{3}{4}$ -inch friction tape, — feet No. 18 B. & S. gauge damp-proof office wire-----

How to do the work

As you proceed with the work on this job you may meet with obstructions that will require tools the handling of which are not described in this lesson. Terrell Croft's "Wiring of Finished Buildings," paragraphs 227–295, pages 170–216, is a reliable source from which to obtain suggestions as to tools and how they should be handled. The blank lines above should be used for listing them. Also use blank space for filling amount of wire approximately needed to do the job.

With a match or lighted candle heat the end of snake or fishing wire until dark red in color. With pliers turn end over to form a closed hook. Allow it to cool. Insert this end into hole bored in plaster or doorcasing at push-button outlet in upper room. Work the snake downward and feed in more snake as you feed. When you have fed in enough snake to reach the floor of the room and the end strikes an obstruction, give it a few twisting turns and try to feed in some more. If the snake feeds in all right, find out whether the end is going down through wall of the lower room to the cellar. If it is not, pick up a pocket in the flooring. Working in pocket between floor and ceiling below, bore a hole up into floor plate and down into ceiling plate of partition studding of room below with a $\frac{1}{2}$ -inch auger bit.

Use extension bit holder where possible. If the snake feeds through to the cellar, the end must come out at some place plumb below feeding point. Find it, bore a hole up into plaster of ceiling, if it is plastered, and pull out enough snake to fasten somewhere near by.

Go back to the outlet. Straighten out the snake to get at its other end. Form a closed hook on this end the same way you did the other. Measure the distance from the outlet to the cellar, double this, and allow about 4 feet more. Now cut your wire. Fold wire into two lengths, forming a loop. Skin about 2 inches of insulation from wire at loop. Fit the bared loop into the closed hook of the snake and fasten it firmly. Have some one in the cellar pull the snake downward while you feed the snake and wire until the hook with wire attached is pulled out into the cellar. Allow about 12 inches surplus at outlet and fasten it around a nail or anything that will hold it. Go to the cellar and detach the wire from the hook of the snake. Leave the loop in the wire.

Repeat this operation and install two wires from the push-button outlet in the pantry to the cellar. Leave the loop in the wire. Always work down to the cellar by the shortest route having the least number of obstructions. If these wires lead down to another location in the cellar, bore another hole in the ceiling and pull them out.

Next go to the push-button outlets at front and rear entrances. Wiring for each in turn feed the hook end of snake into push-button outlet and downward to the cellar. If an obstruction stops it, give it a few twisting turns until it comes out into cellar. Break a hole in the plaster ceiling at each point if necessary. Draw the snake down into cellar until only a few feet remain sticking from the outlet. Measure off two lengths of wire more than long enough to reach the cellar. Skin the insulation from one end of each, twist them together, and fasten them into the hook of the snake. Get a helper to pull snake with wires down into the cellar while you feed it in at the outlet. Fasten these wires so that they will not pull down and become lost in the doorcasing.

You now have one button battery wire and one section wire dropping from cellar ceiling plumb beneath each push-button outlet—eight wires in all. Leave them and proceed to the annunciator outlet in the kitchen. Here again find the hollow part of the wall or partition, bore outlet hole proper distance from floor, insert and feed snake downward to the cellar through cellar ceiling. Measure the distance and obtain wire enough for six wires from this outlet to the cellar. Four of these are section wires to push buttons, one is a button battery wire, and the other a bell battery wire. Bringing both battery wires to the annunciator outlet places the system battery at your disposal for testing the instrument if necessary.

Pick up all ends that drop from ceiling in the cellar. First go to the loops of wires dropped from all push-button outlets. Turn a small strip of friction tape around one of the wires in each loop. Cut the loops. You now have eight ends. Skin 2 inches of insulation from the ends. Join the ends of taped wires together by running another wire from the battery outlet to them. This is your button battery wire. Extend this wire on the ceiling to where the wires from annunciator outlet emerge. Tape one of the wires with a strip of tape, skin insulation off its end, and join this also to extended wire. In the same way extend the section wires separately from push-button outlets to annunciator outlet. Run the wires on ceiling beside the button battery wire. All wires are now run between outlets excepting the bell battery wire. Extend this wire to the battery, running it beside the button battery wire. Be sure all splices are well made and taped. In fastening all wires to the cellar ceiling, tape them all together with friction tape every 5 feet and fasten them with No. 6 Blake insulated staples. Leave them in this condition.

Questions for further study

1. Describe the button battery wire.
2. What is meant by the term "fishing"?
3. Describe a "snake."
4. Why is it good practice to run both battery wires to the annunciator outlet?
5. Describe a pocket.

LESSON XIII

[An annunciator equipment for a private residence.—Job 3]

Installing instrument, devices, and battery, testing and connecting wiring.

A few more complex systems of annunciator equipment are described in Terrell Croft's "American Electricians' Handbook," paragraph 288, pages 536-537. A broader knowledge of annunciator practice is essential to success in this work. Trace the circuits to understand their operations; or you may proceed further with W. H. Timbie's "Essentials of Electricity," paragraph 21, pages 36-41, and learn about the interesting effect of resistance in parallel circuits. Then you may go on and complete Lesson XIII.

Tools and equipment

One four-drop manual reset gravity-drop annunciator (this instrument may be provided with indications printed on white tags, as follows: "Front entrance," "Rear entrance," "Pantry," and "Housekeeper"), two wood push buttons, two wrought-bronze loose-back push-button plates, three cells of No. 6 dry battery, one 5-foot spreading ladder, one bradawl, one soft leadpencil, one No. 13 bell-faced nail hammer, one pair of 7-inch side-cutting pliers, one 2½-inch Champion screw driver, one midget (Valley Pet) screw driver, one single-blade jackknife, one 5-foot zigzag rule, one roll ¾-inch friction tape, four 1½-inch No. 8 flat-head bright wood screws, four ¾-inch No. 5 flat-head bright wood screws, four ¾-inch No. 5 round-head blued wood screws.

How to do the work

The annunciator must be firmly fastened to the wall with wood screws. Set the back board against the surface of the wall after drawing the six wires through one of the holes bored in it. With lead pencil mark where the fastening screws enter. Remove backboard. Puncture plaster at marks with a thin wire nail or bradawl until lath are reached for holding the screws. Use screws long enough to hold the backboard fastened firmly to the wall. Fasten it. Next skin the insulation from ends of wires emerging from hole in backboard removing all kinks and twists and prepare to test them.

At all push-button outlets skin insulation from ends of wires. Care should be taken that the bared wire is scraped clean or the connection will be so poor it will be difficult for the current to flow. Now test the wiring in the following manner: At battery outlet connect the three cells of battery in series. Join the unconnected binding posts of the battery with the wires emerging at outlet after forming helices. Be sure to turn ends of wires in the right direction. Go to the annunciator outlet and, using the annunciator bell, find out which of the six wires at this point are the battery wires. Separate these two from the other four. In order to find out which of these two is the bell-battery wire, twist together the ends of wires at any push-button outlet, preferably the nearest.

Attach one of the battery wires temporarily to a binding post of the bell. Touch the bared ends of each of the four section wires in turn to the other binding post of the bell. If the bell fails to ring with either of them, it is likely that the wrong battery wire is attached to bell. Detach this wire, attach the other battery wire and again touch the bared ends of each of the section wires to the other bell binding post. If bell rings with one of them you have traced out the bell-battery wire; fasten it permanently to the bell binding post. The section wire used to trace it is also tested out; connect it permanently to binding screw of drop its push button is designed to operate. The drop should fall when the bell rings. Untwist the wires at push-button outlet and separate them. Proceed to another push-button outlet, twist the wires, test in the same manner as before until the bell rings, connect the tested section wire to proper binding screw, see that drop registers when bell rings; untwist wires at

this outlet and also separate. Follow this procedure until all section wires are tested out and connected to annunciator binding screws. Tape the end of the button battery wire and coil it up for use when it is necessary to test the instrument when out of order.

At front and rear entrance push-button outlets, each in turn, thread the wires through holes in loose back of push-button plate, turn under heads of binding screws in the right direction, drive screws tightly over them, push surplus back into hole and fasten plate with round-head blued wood screws. In pantry and upper room repeat the operation with wood push buttons. The work is now completed; if one or two more trials are made that cause instrument to respond effectively, you may leave confident that the system will work indefinitely.

Questions for further study

1. Why should bared ends of wires be scraped clean?
2. Suppose one of the annunciator drops failed to work when push button is pressed, where would you look for the "trouble"?
3. How could you test the drop itself?
4. Describe a return-call annunciator system.
5. What would happen if the section wires of front and rear entrance push buttons should accidentally become crossed?

Rehabilitation monograph. Joint Series No. 59.

AUTO MECHANICS

Unit Course—Auto Mechanics 2—Ford Automobile Upkeep and Repair for Owners

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is prepared primarily for the owner (present or prospective) of a Ford automobile who expects to care for his own car. It is assumed that he has little or no experience in handling machines and that he knows but little about the principles or operation of the automobile, but that he has sufficient general education to read with profit the references used in the lessons.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

It is intended that this course will familiarize the student with the various parts, mechanisms, and principles of operation of the Ford automobile, so that he can intelligently care for his car, including the lubrication, adjustment, and minor repairing necessary. By understanding the mechanical principles underlying the operation of the automobile, the owner will derive the greatest amount of pleasure and satisfaction from the use of his car and will be able to secure a maximum of service with a minimum of expense.

NOTE.—This course applies only to the Ford car.

3. LENGTH OF THE COURSE

The work of this course is divided into 20 lessons, each intended to average about one hour of study and practice for the student.

4. EQUIPMENT AND MATERIALS

It is assumed that the school offering this course will provide sufficient equipment to give the pupil ample practice in studying, disassembling, assembling, and adjusting the various parts of the Ford automobile. This equipment should include three Ford automobiles—one designated by letter (A) in complete running order but arranged to easily remove hood, floor boards, and rear of body (back of seat), exposing engine, transmission cover, rear part of drive shaft tubing, rear axle housings and wheels, and car should be placed on standards

to hold it off the floor to permit of operating; one (B) car with dashboard on but with hood, body, mudguards, and running boards removed and parts exposed so far as possible; also one (C) car for disassembling, assembling, and adjusting. There should be several groups of the various integral units of the automobile, such as engine blocks and fittings with the parts involved, magneto, Ford transmission with extra gears for demonstrating gear movements; provisions for fitting and scraping in of main and other bearings; Kingston and Holley carburetors (Ford types), both complete and in section; coil box with four coils for use in connection with wiring practice; one kw. coil so arranged as to permit of disassembling the several parts, consisting of box, vibrator points and supports, condenser, secondary coil, primary coil, and core, with provision for assembling and operating, also one magneto of the type used with the Ford magneto for showing the lines of magnetic flux by means of iron filings; and assembly of the rear wheels, axles, and differential complete but without housing.

The equipment should also include the standard kits of tools furnished with the car, with such additions as the owner of moderate means would be likely to possess. It is not intended in this course to train specialists in automobile repairing, hence the student will not be called upon to use any special or unusual tools or appliances, even though the school shop may possess them for the work of the other courses.

The school shop will furnish the commonly used automobile supplies such as oils, greases, cotter pins, lock washers, etc. The judgment of the instructor of the class will determine the necessary items.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education, shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the method of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available it is recommended that final rating be recorded as follows: The average student will be rated *good*, the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student showing results not up to the "fair" standard should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value, both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

- (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
- (b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

(2) Finished product:

- (a) *Accuracy*.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.
- (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?

(3) Interest:

- (a) *Attitude toward work.*—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?
- (b) *Studiosness.*—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?
- (c) *Possibilities of growth.*—Is the student likely in due time to receive promotion to positions of greater responsibility?

(4) Test problem:

A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

6. OUTLINE OF LESSONS

- (1) Getting acquainted with your car.
- (2) The principles of the automobile gas engine.
- (3) Parts of the Ford engine, names and uses.
- (4) Care and lubrication of engine.
- (5) Cooling system for engine.
- (6) Carburetor and fuel feed system.
- (7) Valve system.
- (8) Valve grinding; scraping and fitting bearings.
- (9) Complete ignition system.
- (10) Timing the ignition system; the lighting system.
- (11) Rear wheels; hand-lever brake; front wheels.
- (12) Rear axle; differential.
- (13) Drive shaft, including universal joint and drive shaft pinion.
- (14) Rear spring suspension, tension tube, rear radius rods, front spring suspension, front radius rods, spring tie bolts, spring hangers, spring clips, spring retainer clips.
- (15) Steering-gear system.
- (16) Transmission and clutch, names and function of parts.
- (17) Transmission and clutch control, adjustment.
- (18) Review of all of chassis parts; study of frame; engine suspension; adjustment of brakes, both feet and hand lever, both shop and road method.
- (19) Tires; driving on road.
- (20) Trouble hunting.

7. BOOKS AND REFERENCES

The book recommended for study in connection with this course in Pagé, *The Model T Ford Car and Ford Farm Tractor*, Norman W. Henley Publishing Co., New York. References to this book are given with each lesson. (Names of parts as found in this book are not used, the Ford terminology being strictly adhered to.)

The student should also secure the chart of the Ford model T car arranged by Pagé; also the Ford Manual, obtainable from the Ford Motor Co., Detroit, Mich.

8. GENERAL DIRECTIONS TO TEACHERS

The lessons outlined for this course are designed to enable the student to work individually with a minimum of attention.

At the beginning of the lesson the instructor should go over the new assignment with the student, calling attention to difficulties that may be anticipated, seeing that the necessary materials are provided, etc. The instructor will be alert to the activity of the student while working out the lesson, accessible for help in answering questions that may arise, but should ever be mindful of the fundamental principle of pedagogy, namely, not to do for the student when the latter should do for himself. At the end of the lesson the instructor should check up the work of the lesson with the student and make sure that the essential points have been covered.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets comprising Part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

INTRODUCTION

To the student:

This course is intended to familiarize you with the various mechanisms of the Ford car and to teach you the fundamental principles of operation of the various parts. By learning these details you will receive greater pleasure and profit from the use of your car and will be able to obtain a maximum of service with a minimum of expense.

The lessons are planned to help you to pursue the course with but little attention from your instructor. He is with you for such assistance as you really need, but you should think twice and try to study out each question or solve each difficulty for yourself without his help just as far as possible.

Before proceeding very far you will learn that the care of an automobile requires time, attention, and hard work. You must expect to get your hands greasy, and working clothes are very desirable. It is not a parlor job.

Lesson I.—Getting acquainted with the car

A. Study:

Pagé, "Model T Ford Car and Ford Farm Tractor," pages 21 to 24.

Also, Chassis Chart in Ford Manual.

B. Practice:

1. Use Ford car, shop equipment, model (A).
2. Remove the hood over the engine. Locate the following parts, study carefully and determine as far as you can the purpose, operation and connections of each: Engine, radiator, radiator filler cap, radiator connections to and from engine water jackets, radiator cooling system drain cock, radiator fan, engine inlet manifold, carburetor, carburetor priming rod, gasoline supply pipe to carburetor, exhaust manifold, valves, cylinder heads, cylinder block crank case with lower cover, breather pipe for filling engine crank case with oil, oil drain plug for engine, spark plugs (ignition), commutator (ignition).
3. Remove the foot boards in front of the driver's seat, also transmission cover sloping door. Locate and study the following: Transmission cover, reverse pedal, clutch pedal, brake pedal, supports for pedals, reverse band, slow speed band, brake band, band springs, hand brake lever assembly, magneto contact assembly, coil box on dash and switch, steering wheel and column, gas and spark levers on wheel sector, and linkage to carburetor and commutator, speedometer.
4. Remove rear of body back of seat. Locate and study the following parts: Gasolene or fuel tank under seat, gasolene tank filler cap, gasolene tank drain cock and shut-off valve, gasolene tank pipe line to carburetor, universal joint, drive shaft tubing, rear axle housing (enlarged portion at center showing location of differential), rear wheels, rear radius rods, front axle, front wheels, front radius rods, front spring suspension, rear spring suspension.

B. Practice—Continued.

5. Place transmission cover sloping door back and under the guidance of the instructor and proceed as follows:

- (a) Learn to crank the engine properly; have ignition switch off.
- (b) Crank and start the engine by the following method, which method should be used at all times at this school:
 - (1) Set hand or emergency brake back to lock rear wheels, which also releases clutch and puts transmission in neutral.
 - (2) Set spark lever on wheel sector at full retard.
 - (3) Set gas lever on wheel sector slightly open or at what you will determine to be the proper starting position.
 - (4) Only when necessary (with switch off) pull priming rod out, fully choking carburetor, and at the same time crank engine about three turns over.
 - (5) Place switch to battery, if dry cells or battery is on car; if not, place switch to magneto.
 - (6) Start engine by cranking or by self-starter if there is one.
- (c) After starting engine—
 - (1) Place gas lever so as to just idle engine.
 - (2) Advance spark to what will be determined a proper position for idling speed of engine.
 - (3) Make certain that priming rod is fully backed to completely open the fixed air inlet of the carburetor.
 - (4) If switch is on battery place on magneto.

6. Operate the pedals and hand brake lever, as shown below.

- (a) Put foot on slow speed pedal and place to neutral, releasing hand brake lever fully, and note that wheels stand still.
- (b) Put slow speed pedal down fully to give slow speed and note that wheels move forward slowly.
- (c) Put slow speed pedal at neutral and depress down reverse pedal. Note that rear wheels revolve more slowly backward.
- (d) Put hand lever to neutral and operate reverse pedal.
- (e) Put slow speed pedal at neutral, put hand lever forward fully, release slow speed pedal and note that rear wheels move more rapidly than in other speeds and in a forward direction.
- (f) From running position in high with gas lever on sector of wheel set to idle engine put slow speed pedal at neutral quickly and try breaking with brake pedal, applying gradually, however. Try hand brake lever in same manner.
- (g) Practice these operations A to F, inclusive, only enough to understand the function of the parts involved. Make certain that all parts included in lesson 1 can be located immediately when their names are called.

C. Questions:

Verbal and written answers required as called for.

- 1. Name in writing all parts included in Groups 2, 3, and 4.
- 2. Have the instructor point to the various parts and give each its proper name (name to be given by student).
- 3. Describe in writing the function of all pedals and of the hand-brake lever.

Lesson II.—The principles of the automobile gas engine

A. Study:

Pagé, pages 45 to 62; also Ford Manual.

B. Practice:

- 1. Use Ford car, shop equipment, model "A"; with crank case removed use separate Ford engine.
- 2. Take off cylinder valve cover.
- 3. Take out spark plugs to relieve compression.

B. Practice—Continued.

4. Locate exhaust connections to cylinder; directly beneath note No. 1, 2, 3, and 4 exhaust valves, counting from radiator end, the nearest cylinder to the radiator being considered as No. 1, the nearest to the dash as No. 4.
5. With the number of each exhaust valve in mind, with ignition switch off, crank the engine slowly and note the order in which the exhaust valves are moved, beginning with No. 1; it will be seen that the sequence will be No. 1, 2, 4, and 3. This sequence is termed the "firing order," because the explosions will occur within the cylinders 1, 2, 4, 3 successively. Understand that complete cycle of movements in one cylinder likewise takes place in the following cylinders in accordance with firing order, until the cycle has been completed in all four cylinders, to be followed by a repetition over and over.
6. Replace the spark plug in cylinder No. 1, the remaining plugs keep out, and crank to note the difference in effort required on the compression stroke for cylinder No. 1 as compared with that required for cylinders Nos. 2, 4, 3; this embraces the fact that compression is very evident; losses in compression may therefore be detected, which subject is considered in another lesson.

C. Questions:

1. What does the automobile gas engine do to develop the power delivered?
2. What is meant in general by the term "cycle"?
3. What is meant by the phrase: "4-cycle gas engine"?
4. In a 4-cycle gas engine how many of the following are there to one cycle:
 - (a) Revolutions of the crank shaft.
 - (b) Revolutions of the cam shaft.
 - (c) Strokes of the piston.
 - (d) Opening and closing of the inlet valve.
 - (e) Opening and closing of the exhaust valve.
 - (f) Explosions.
5. Give a complete description of the action of a 4-cylinder, 4-cycle gas engine.
6. What is the effect of compression on the action and output of the engine?
7. How are the gases caused to "explode" in the cylinder?
8. Why is it necessary to have the spark occur so as to cause the explosion to take place at a definite time relative to the position of the piston?
9. Why do we have what is termed "retarded" and "advanced" spark and exactly what is meant by these terms?
10. Trace the passage of the burned gas as it is forced out of the cylinder on the exhaust stroke.

Lesson III.—Parts of the Ford engine, names and uses

A. Study:

Pagé, pages 45 to 62, also Ford Manual.

B. Practice:

1. Use Ford car, shop equipment, model (B), also separate engine exhibits.
2. Go over the entire engine to thoroughly understand the location and functions of the following parts: Cylinder, cylinder head, cylinder head outlet connection (water), cylinder front cover, cylinder water inlet connection, cylinder water jacket plug, piston, piston pin, piston pin bushings, piston ring, connecting rod, crank shaft, crank shaft rear bearing cap, crank shaft front bearing cap, crank shaft center bearing cap, crank shaft front bearing liner, crank shaft center bearing liner, crank shaft rear bearing liner, crank shaft starting pin, cam shaft, cam, cam shaft front bearing, cam shaft center bearing, cam shaft rear bearing, cam shaft bearing ring, time gear (large) or cam shaft, time gear (small) on crank shaft, valve, valve spring, valve spring seat, valve spring seat pin, push rod, push rod bushing, exhaust manifold, exhaust pipe pack nut, inlet pipe, inlet and exhaust pipe gland, inlet and exhaust pipe clamp, breather pipe, crank case, crank front bearing cap, crank case oil cock, crank case oil cup plug, crank case oil tube, crank case arm block, crank case lower cover, cylinder valve cover, fly wheel.

C. Questions:

1. Student should give names to parts selected or pointed out by instructor.
2. Define in such a way as to give purpose or function of the following parts: Crank case, cylinder, cylinder head, piston, piston rings, piston pin, connecting rod, crank shaft, cam shaft, cam, push rod, valves, valve springs, time gears, bearings, flywheel.
3. Where is the combustion chamber?
4. What is meant by valve port?
5. Show valve ports on engine.
6. Why is it necessary to have clearance between the end of valve stem and push rod?
7. How are piston rings manufactured to cause them to exert a nearly equal pressure around their entire surface against the walls of the cylinder?
8. Does the piston make a tight joint with the walls of the cylinder?
9. How is the wrist pin held?
10. Describe in detail how the several engine bearings are inspected for proper fit and adjustment, and if not right how they should be fitted.

Lesson IV.—Lubrication and care of engine and chassis

A. Study:

Pagé, pages 148 to 153 and 91 to 96; also Ford Manual.

B. Practice:

1. Use Ford car shop equipment, model "A".
2. Use Ford Manual lubrication chart and learn to lubricate on the "day and mileage basis" as set forth. For practice lubricate every part, making a list of the names of all parts lubricated and the kinds of lubricant used.
3. The crank case of the engine should be drained of oil and cleaned with kerosene as outlined in the Ford Manual, but in this connection it will be advisable to have the engine warm, as after coming in from a run, when the kerosene is put in, also allowing the kerosene to remain in the crank case overnight; further, when kerosene is first put in, with the ignition switch off, crank the engine over a few turns to thoroughly kerosene all parts.
4. Always use the proper lubricant for the several parts and keep in mind that it must be suited to the season of the year.

C. Questions:

1. What kind of oil should be used in the crank case of the motor?
2. What kind of grease is used for front wheel bearings, universal joint, steering gear, differential and rear axle bearings?
3. Is it advisable to lubricate the commutator (ignition) and if so how often and with what?
4. While running the car, what will be the indications of an excess of lubricating oil in the crank case? (and to make a distinction at this time), what will be the indication of too rich a gas mixture?
5. How do you lubricate the spring leaves? If necessary to take down, what method do you use to reassemble properly?
6. Name all parts to be lubricated with the squirt can; What kind of oil is used in the squirt can?
7. What are the causes of carbon formation in cylinder?
8. While driving, what are the indications of troublesome amount of carbon in the cylinders?
9. With the Ford system of engine lubrication why is it necessary to inspect oil level in crank case frequently and regularly?
10. What precautions are necessary to make certain as to the level of the oil in the crank case?

Lesson V.—Cooling system for engine

A. Study:

Page, pages 86 to 89 and 153 to 158; also Ford Manual.

B. Practice:

1. Use Ford car, shop equipment "A"; also sectioned radiator exhibit.
2. Understand the construction of the radiator which is of the simple "tubular" type.
3. Locate the fiber cap and tube, overflow pipe, tracing the latter from inside to outside and down to the bottom of radiator; locate drain cock for radiator system; also trace complete circuit of water from lower part of radiator to engine water jacket out at the top and back to the upper part of the radiator.
4. Understand that this cooling system is of the thermo syphon type.
5. Note fan adjustment; try engine at low and higher speeds and note the difference in the velocity of the air drawn through the radiator by means of the fan, which wipes off the heat collected by the metal fins, which in turn have conducted the heat of the water to their surface.
6. To protect the radiator in freezing weather, use *only* a mixture of alcohol and water in proper proportions for climatic conditions or the same with a little glycerine added; use nothing else, and especially avoid the use of patent compounds which tend to fill up the radiator or act upon it chemically. The radiator may also be protected by the use of curtains or shutters lessening the amount of surface exposed in the front of the radiator for the inlet of air; these are obtainable at the accessory stores.
7. Avoid the use of scale-forming water so far as possible. At regular intervals rinse out the water system thoroughly with clean water, having the water enter from above and also from below if possible. Once every six months clean out scale with a sal soda solution as directed by instructor.
8. Have experienced radiator repair man fix radiator if leaks develop. When a new section is put in see that the repair man does not insert what is merely a closed block (for appearance only), but insist upon a portion that will be interconnected as to permit of circulation through it, thus not cutting down the radiator capacity.

C. Questions:

1. How high must the level of water be in the radiator to make certain of circulation?
2. Why is it easier to warm up a cold engine in winter with the thermo syphon system of cooling and more quickly than with a pump circulation cooling system?
3. What will be the first and most likely trouble if the engine is not cooled?
4. Why is it necessary to use a cooling system? Give all reasons.
5. At what temperature, in degrees of Fahrenheit, should we carry the water at the top of the radiator and why should we try to keep it approximately at this point?
6. How can you determine whether the water is circulating properly throughout the cooling system?
7. What prevents the radiator, which is of a very light construction, from bursting when the water steams? In this connection, what precautions should be taken to maintain the means by which the breaking of the radiator is prevented?
8. What causes overheating of the engine?
9. Explain how to clean the radiator with sal soda.
10. What are the advantages of the thermo syphon system of cooling?

Lesson VI.—Carburetor and fuel feed system

A. Study:

Pagé, pages 62 to 71; also Ford Manual.

B. Practice:

1. Use Ford car, shop equipment, model "A," also Ford engine on stand in operating condition; also sectional model of the Holley and the Kingston carburetors (Ford type).
2. Study both carburetors in section to understand thoroughly their make-up and the function of the various parts.
3. Make certain that the engine is in good running order; this pertains to ignition and all other factors that would tend to mislead when carburetor is to be adjusted; stop engine and throw carburetor out of adjustment, counting the turns of the needle valve required to close it from the former setting. Use the Ford instructions and readjust for an average speed condition, making certain that the mixture is such as to permit of the engine's just idling, with the gas lever at a position of no opening on the wheel sector. Give the subject of carburetor adjustment considerable time, starting by use of the choke or primer and then without its use, and working at various speeds until you secure sufficient mastery of the subject to be accurate to a fair degree. It is very necessary to know how to tell when the carburetor is set so as to give both power and economy, while delivering a proper output at the engine for the various speeds and hill climbing.

C. Questions:

1. State exactly what the carburetor is intended to do.
2. Name all the parts of either the Holley or Kingston Ford type carburetors, describing the action throughout.
3. Why is heated air used for the carburetor at certain times of the year or throughout the year and what is the mechanical arrangement or means for providing heated air?
4. How can you tell that you have gasoline in the carburetor when engine stalls for some reason unknown?
5. Explain in detail how you would adjust a carburetor on the Ford car.
6. What attention should be given the gasoline feed line to keep it free of dirt and water?
7. What is meant by specific gravity of gasoline or reading of the Baumé scale?
8. What degree Baumé is the average gasoline furnished to-day?
9. While driving, what are indications of too weak a mixture, too rich a mixture, and a proper mixture?
10. What is the effect of altitude, cold, and heat on the action of the carburetor?

Lesson VII.—Valve system

A. Study:

Pagé, pages 59 to 61 and 251 to 256; also Ford Manual.

B. Practice:

1. Use engine of shop equipment suited to demonstrate valve, push rod, cam shaft, time gears, etc.
2. Learn to locate inlet and exhaust valve with regard to each particular cylinder by means of exhaust manifold connections.
3. Remove valves from engine, using proper valve-lifter tool. Learn to disassemble valve-seat pin, valve-spring seat, spring and valve, and reassemble in a proper way. Inspect the action of the push rod and note that push-rod clearance may be measured with a thickness gage or with cardboard or paper.
4. The Ford push rod is not provided with an adjustment means.

B. Practice—Continued.

5. In case of wear causing too much clearance at push rod, the valve is generally replaced, but the stem may also be peened out to a proper length with a hammer. With too little clearance the end of valve stem may be ground to make the stem shorter. If desirable an adjustable cap may be placed on the end of valve stem having shims inside.
6. Note the manner of mounting the cam shaft, the shape of the inlet valve cam compared with that of exhaust-valve cam; note the means of lubricating the cam shaft.
7. Note cam-shaft gear; count the number of teeth on it; also the number of crank-shaft time gear. Note the markings of these gears which are used for valve settings.
8. Take off cam-shaft gear and set valves—
 - (a) Without regard to the marks on gears so that exhaust valve closes when the flywheel has passed its position for top dead center by about 1 inch measured on the rim of the flywheel.
 - (b) Set valves by marks on gears and in accordance with Ford Manual.

C. Questions:

1. Describe in detail how you would time the valves in the event of having to replace a broken time gear.
2. What clearance should the exhaust-valve push rod have? The inlet-valve push rod?
3. What is the effect of too much clearance; of too little clearance?
4. Why is clearance necessary?
5. What is a good way to determine the proper adjustment of push-rod clearance when the engine is operating at its normal temperature?
6. What are the reasons for the valves being timed so as to open and close at the time they do with regard to the position of the piston?
7. What causes a valve to stick?
8. Why do valves warp?
9. What gives rise to valves leaking and what are the indications of a leaky valve?
10. What kind of lubricant may be used on the valve stem?

Lesson VIII.—Valve grinding, scraping and fitting bearings

A. Study:

Pagé, pages 227 to 231 and 236 to 251; also Ford Manual.

B. Practice:

1. Use shop-equipment engine mounted on stand, arranged for this purpose.
2. Valves should be ground with a mixture of flour, emery and oil, powdered glass and oil, or valve-grinding compound such as "Clover Brand." When valves are burned or cut through or require an unusual amount of grinding, they should first be faced in a lathe or if necessary with a file by hand, and then partly ground into seat with a coarse grade of emery, to be finished afterwards with a finer grade. Always be careful to note whether the valve stems have become worn, in which case there will be too much side play, and when grinding be careful to prevent the grinding compound reaching the valve-stem guides or other parts than the valve face and seat. The valve should be ground to bring up not more than about $\frac{1}{16}$ " of width of bearing surface, and the ground part should present a fine thread-like appearance rather than a smooth surface.
3. Many types of valve-grinding tools are used, some of which give a back-and-forth movement to the valve while the hand is carrying the brace handle of the tool around continuously. Whatever the tool used may be, even though a screw driver, always grind with a short back-and-forth movement, lifting the valve off its seat every little while and changing the position of the valve on the seat. The pressure exerted on the valve should be light, especially just after putting on new compound. Make certain that all grinding mixture is removed from the parts and everything is thoroughly clean before assembling. It is well to use a spring undervalue so that it will automatically lift up when grinding.

B. Practice—Continued.

4. *Scraping* should first be practiced on a large bearing with an ample amount of babbitt to enable the student to acquire the proper method of using the scraper. Endeavor to use a slight wrist movement in rotating the scraper while it is also pushed forward by the arm or hand to produce a shearing action. To acquire this action will take some little time. Use Prussian blue on the rotating part to mark the bearing. The instructor will demonstrate these methods.

C. Questions:

1. How do you find a leaky valve on the engine? How do you locate the particular cylinder? And decide whether it is an exhaust or inlet?
2. Which valve, inlet or exhaust, is likely to leak first?
3. What method do you use in grinding a valve into a seat? Describe in detail.
4. How can you tell if valve spring is strong enough to properly seat valve?
5. In trying to locate a loss in compression what is the first thing to do if there is no decided indication?
6. What will be the indications while running (not considering a possible pound) if part of the valve head should break off? (This sometimes happens without interfering with the movement of the piston.)
7. What are the causes of loss of compression? Give a proper logical system by which to proceed to locate the cause.
8. Describe in detail your method of scraping in a connecting rod (crank-pin end) box while keeping the rod in proper alignment.
9. How would you scrape in a crank shaft to make provision for proper alignment both up and down and parallel to the surface of the cylinder block?
10. Suggest other points that should be kept in mind when scraping bearings.

Lesson IX.—Complete ignition system

A. Study:

Page, pages 71 to 86 and 256–257; also Ford Manual.

B. Practice:

1. Use shop equipment with engine provided with complete magneto; also coil box with four coils for separate use; one K. W. coil so arranged as to permit of disassembling the several parts consisting of all the elements; two magnets of the Ford magneto type; iron filings; pieces of magnetic and nonmagnetic material; Ford car, shop equipment, Model "A." Also set of Ford dry cells and one dry cell sectioned.
2. Take a set of Ford dry cells and measure the voltage and amperage of each cell with a voltmeter; connect up the four cells in series and take the voltage and amperes of the four cells. One cell should show at least $1\frac{1}{4}$ volts and 25 amperes.
3. Take the demountable vibrator coil and separate into all its parts, namely, the core, primary winding, secondary winding, vibrator points, and condenser. Trace out all connections and reassemble. Connect up to dry cells and connect secondary cable from coil to a spark plug and operate, noting the high-tension current jump the gap at the spark-plug points. Cut out the condenser, noting the decreased spark at the spark plug and the increased sparks at the vibrator points. Connect condenser in again and note that there is practically no sparking at the vibrator point now, while there is a much larger spark at the spark plugs. The student should grasp just what this means.
4. Take the shop equipment coil box and with coil removed detach all wiring, including that at switch, making a sketch as you proceed; understand the scheme of wiring as related to the coil; rewire and put coil in box and test its action with the four dry cells to see that the work is right. Note how to adjust vibrator points to secure best vibrator action. With the Ford system the vibrator points may be set without regard to the consumption of current by reason of the current source being a magneto.

B. Practice—Continued.

5. Take the shop equipment magnets and iron filings to study magnetic action. Try a nonmagnetic material such as brass and note that it is not attracted by the magnets, whereas the magnetic material iron is very strongly attracted. This quality in a material is called susceptibility or nonsusceptibility to magnetism. Also note that the magnets have a north and south pole, where the magnetism is strongest, but of different polarity and a neutral point. Note that the north pole of one magnet repels the same pole of another magnet while attracting the south pole of another magnet.
6. You have already noted how magnetism is produced in the core of the vibrator coil (by passing current around the core through a copper-wire conductor); note that the magnets of the Ford magneto are mounted so as to rotate with the flywheel, while the field coils consisting of a single wire arranged to be coiled at each of the 16 field poles is continuous and is finally passed out at the magneto contact assembly terminal, the other end of wire being grounded to the metal of the engine.
7. Study the action of the commutator (which would most properly be called timer), noting that it has a considerable length of contact for keeping a closed circuit.

C. Questions:

1. Define or explain the following terms: Volts, amperes, positive and negative poles, north and south poles, magnetic flux, neutral point, resistance to electricity, electric conductor, nonconductor, susceptibility to magnetism, nonsusceptibility, direct current, alternating current, short circuit, ground.
2. What is the approximate voltage (or pressure) of the primary circuit current entering the coil and what is the (roughly) approximate voltage of the secondary circuit delivered to the spark plug?
3. What is a condenser? How is it made and what is its function?
4. What purpose is served by using vibrator points?
5. Explain in detail how to clean a spark plug and also how to adjust for proper clearance between the points and state what this clearance should be.

Lesson X.—Timing the ignition system—The lighting system

A. Study:

Pagé, pages 71 to 73, also 158 to 165; also Ford Manual.

B. Practice:

1. Use Ford car shop equipment, model "A"; also a set of four dry cells.
2. Take down all wiring on the Ford car and as you proceed make memorandum of the method of wiring or make a wiring diagram.
3. Rewire by the wiring diagram without reasoning, working simply automatically.
4. Reason out the complete scheme of wiring.
5. Give your rule for timing this ignition system in detail.
6. Wire up two headlights in accordance with Ford Manual.
7. Take a spark plug apart, clean and reassemble and adjust the points.

C. Questions:

1. Explain in detail your method of wiring up the Ford car, making a sketch and also including the proper timing for sparks.
2. What is the cause of a continuous buzzing of the vibrator points? How can you locate with this ignition system and by the quickest method the cylinder in which ignition is not taking place?
3. What is the effect of dirt on the vibrator points, and how should these points be cleaned? What is the effect of the points becoming pitted? How corrected?
4. What causes a failure to spark at the spark plug points when there is current at the spark plug terminal?
5. Give a complete outline of your method of tracing ignition troubles and devices used in this connection.

Lesson XI.—Rear wheels, hand-lever brake, front wheels

A. Study:

Pagé, pages 122 to 125 and 202 to 208. Also cuts 1, 5, 32, 34; also Ford Manual.

B. Practice:

1. Use Ford car; shop equipment "C." Also rear wheels, axles, and differential complete without housing assembly.
2. Disassemble rear wheels to note construction consisting of hub cap, castle lock nut, with cotter pin, taper hub of wheel fitted with keyway and key, dust cap, felt washer, brake shoes, fulcrum pin for brake shoes, cam for spreading brake shoes, springs on brake shoes, cam rocker shaft, rear axle housing flange to which brake shoes are attached, brake drum removal from wheel, attachment to housing flange of radius rods by two bolts; attachment to flange of spring perch; etc. Reassemble wheel and note that it turns freely (using the rear axle wheel assembly shop equipment). If this does not prove to be the case, locate the interference in connection with your wheel assembly, and make right.
3. Hand-brake lever connects to the controller shaft by means of an adjustable clevis which can be used to lengthen or shorten the brake rod, and other end of brake rod is attached by a fixed clevis to a lever arm, which, in turn, is fixed to the brake cam shaft.
4. Front wheels; disassemble, noting the order in which parts are removed, and reassemble to the point of taking up the lock nut which adjusts the bearing cone; take this nut up tight enough to just grip the wheel, then free only sufficiently to permit of the wheel's finding its center of gravity when it is rocked back and forth slightly; this method of adjusting front wheels is to be preferred over trying wheel by taking hold of the outside of spokes and looking for any lost motion.

C. Questions:

1. Name the parts removed in taking wheel off and your method of removing both as to order and tools used.
2. Name the adjacent parts to rear wheel exposed when rear wheel is dismantled.
3. What will cause the taper hub of the wheel to become scored?
4. Is it advisable, in the event of the key holding the wheel breaking to have the car towed with the wheel turning on the taper axle shaft?
5. Why in the case of the Ford is there no lining for the brake shoes?
6. Is there provision for oiling the brake shoes, and if not, why?
7. After reassembling by reason of replacement parts being put on, if the wheel sticks, what is the probable cause and what indications will there be to show cause without taking wheel down? (Everything else being right.)
8. Why in the front wheel system of bearings are large balls used on that part of the bearing nearest the car?
9. What is the character of load coming on the outer ball race and balls of front wheel and why is this bearing small, comparatively?
10. How should wheel bearings (front) be cared for in the sense of lubrication and cleaning? What kind of lubricant should be used?

Lesson XII.—Rear axle—Differential

A. Study:

Pagé, pages 111 to 114, 115 to 122, and 270 to 276; also Ford Manual.

B. Practice:

1. Use Ford car, shop equipment "C"; also rear wheels, axles, and differential complete without housing (assembly).

B. Practice—Continued.

2. Jack the car up by the frame at about the point of the rear step for running board, putting the weight of the springs entirely on the frame, thus relieving the wheels and spring perches. Disconnect radius rods at front end of drive shaft tube; disconnect drive shaft bearing housing from rear axle housings; disconnect hand lever brake rods. This will permit of drawing wheels and complete rear construction with radius rods, but without drive shaft tubing from under car; place this rear construction on a proper support, take off wheels, break the right and left housing joint and pull housing off axle. This will bring to view the outer roller bearings in their sleeves situated in the outer ends of the right and left hand housings; also the roller bearings at the differential ends of the axle together with the sleeves, also the thrust bearings on both sides of the differential and the differential itself.
3. Put on wheels with keys so as to have a means of turning the axle shafts and note the action of the differential under the following conditions:
 - (a) When one wheel is held and the opposite wheel turned.
 - (b) Turn both wheels.
 - (c) Operate the differential by means of the ring gear (called master gear) and note action.
 - (d) Turn both wheels backward. Note action of differential.
4. Take down differential, bringing to view as separate parts the ring gear, the differential housing, the intermediate gears or axle shaft gears and the small pinions (differential). Study the action of the differential by holding the spider on which the small differential pinions are supported and bring about the several actions as above.
5. In breaking down the differential note the means used for holding the intermediate or axle shaft gears consisting of key and half ring segment.

C. Questions:

1. Describe in exact detail just how you break down rear axle to expose the differential as a unit (this does not include breaking down the differential). In doing this name all parts.
2. Break down the differential completely. Describe how you do this and name all parts.
3. Reassemble differential and rear axle housing and wheels, and state exactly how you proceed, step by step.
4. What serves as a means for taking the thrust lengthwise of the rear axles?
5. What type of rear axle construction is used with the Ford car?
6. What means are provided for lubrication, what parts are lubricated, and what lubricant is used for the rear axle bearings, differential, etc.?
7. In case a sleeve for rear axle bearings is broken, how is it removed and what will be the effect of keeping it in the car instead of replacing?
8. Why are the right and left hand sleeves used in the axle housings at the differential ends?
9. What is the purpose of the differential?

Lesson XIII.—Drive shaft—Universal joint

A. Study:

Page, pages 110 to 115; also Ford Manual.

B. Practice:

1. Use Ford car, shop equipment "C."
2. Disassemble rear drive shaft by breaking the joint at the bearing housing at the differential and by driving out pin at the forward end; also taking off radius rod, nuts, which permits of withdrawing the drive shaft and tubing complete. Disassemble the drive shaft and tubing and drive shaft bearing for radial load and also the thrust bearing in accordance with directions given in Ford Manual.
3. Take down universal joint by breaking the joint of the coupling ring and expose the members. Study this universal construction and understand thoroughly its purpose and need.

C. Questions:

1. Describe in detail your method of breaking down the parts of the drive shaft assembly, naming all parts.
2. What is the purpose of both the roller bearing and the ball bearing in the housing containing them?
3. What is the purpose of the universal joint?
4. At what points does the drive shaft receive support?
5. How is the drive shaft pinion attached to the drive shaft, and what regulates the placement of this drive shaft pinion with reference to the ring or master gear of the differential? In other words, why should it not be adjustable?
6. How do you lubricate the drive shaft roller bearing and thrust bearing at the differential end? Also the drive shaft bearing in the bushing at the universal end?
7. When should the universal joint be cleaned, and how?
8. What lubricant should be used for the roller bearing and thrust bearing of the drive shaft, for the end of drive shaft contained in bushing and for the universal joint? Describe in detail and in order how you would assemble the drive shaft and universal joint.
9. What is another name often given to what is termed the "Drive shaft tube" on the Ford car?
10. What is the function of the drive shaft tube in addition to serving as a housing?

Lesson XIV.—Rear spring suspension—Front radius rods—Torsion tube—Spring tie bolts—Spring retainer—Rear radius rods—Spring hangers—Front spring suspension—Spring clips—Clips, etc.

A. Study:

Pagé, pages 37 to 40; also cuts 94, 1, 2, 3, 4, 5, 6; also Ford Manual.

B. Practice:

1. Use Ford car, shop equipment "C."
2. Dismantle rear spring suspension, noting where there is a tendency to wear. Graphite the leaves of the springs with a mixture of graphite and gasolene. (Gasolene evaporates quickly enough to prevent a dripping down of the mixture over other parts.)
3. Note the type of spring suspension. Disassemble front spring suspension in same manner. Thoroughly understand the purpose of all these parts.

C. Questions:

1. What is the function of the torsion tube?
2. Why are rear radius rods used?
3. Why are front radius rods used?
4. What should be done in the event of the springs not only becoming dry but also rusty between the leaves?
5. Why do we lubricate the springs, and how often?
6. How are the smaller parts, such as clevis, pins, rocker arms, and parts that have slight rubbing contacts, oiled, and with what kind of lubricant?

Lesson XV.—Steering-gear system

A. Study:

Pagé, pages 125 to 128; also Ford Manual.

B. Practice:

1. Use Ford car shop equipment "C."
2. Disassemble the complete steering group consisting of steering-gear wheel, steering gear (planetary type), steering post, steering-gear tubing, etc., etc. Note the manner in which all parts are adjusted one to the other and understand the purpose of each.

B. Practice—Continued.

3. The steering-gear group is a very important part of the car to keep in adjustment and free of wear. It must be inspected at regular intervals and properly lubricated as set forth under lubrication. The type of gear used with this steering-gear system is different from that of other cars and is very reversible; that is, when the wheels strike anything in the way of an obstruction they turn and actuate the entire steering mechanism, causing the wheel to tend to turn in the driver's hand. For this reason it is necessary to keep a tight hold on the wheel under all conditions.
4. Assemble the entire steering group, noting if there is any lost play and making a record if such is the case of any parts thus showing wear.

C. Questions:

1. Name the parts making up the steering-gear group, including the front axle.
2. Name the parts making up the steering gear itself.
3. What unusual care must be taken in operating a Ford car as regards using a steering wheel?
4. How often and with what should the steering gear and other parts of the steering-gear group be lubricated?
5. What device is used to enable one to turn the car around a corner and without causing undue wear on the tires?
6. Why do the front wheels have what is known as undergather and what is meant by this term and how much undergather should the wheels have?
7. Why do the front wheels have foregather? What is meant by foregather? How much foregather should the front wheels have?
8. What will be the result of too much foregather?
9. How can the amount of foregather be best determined?
10. How can the amount of undergather be best determined and how is undergather provided and how is foregather provided? And what adjustment have we for changing foregather and is undergather subject to adjustment?

Lesson XVI.—Transmission and clutch

A. Study:

Page, pages 262 to 270 and 99 to 110; also Ford Manual.

B. Practice:

1. Use Ford transmission; also extra gears for demonstrating gear movements, having all assembled on an engine stand.
2. Disassemble complete transmission, taking off all parts, inclusive of clutch disks; thoroughly understand the construction of these parts and be able to name each.
3. Hold the slow speed drum by hand while turning the fly wheel in a forward direction (with reference to the car), until the movement of the driven gear resulting is fully understood. An understanding of this will serve as a key to the entire planetary action. Next follow this up by study of the reverse drum action. This will check up your understanding of the slow-speed drum.
4. The actual driving movement is under all conditions finally delivered to the driving plate through its attachment to the brake drum. In the case of slow speed forward and reverse speed, the brake drum is actuated by means of the driven gear through a planetary action. In the case of high speed forward only the disks within the brake drum come into play and so operate as to receive the drive of the transmission shaft from the engine through the clutch disk drum, which engages certain of the disks which in turn frictionally engage with the other disks which are locked so far as rotative movement to the brake drum, causing the latter to rotate the driving plate.
5. It is difficult to fully comprehend the action of this transmission, but by noting the number of teeth on each of the triple gears and on the gears on the extensions of the drums, which are the driven gear, slow-speed drum gear and reverse drum gear, we can determine the direction of movement as well as speed of the driven gear, which will finally actuate the driving plate.

C. Questions:

1. Explain why when the slow-speed drum is held with the engine turning the resulting movement of the rear wheels is forward rather than backward.
2. Explain why in high speed the whole planetary transmission rotates as a unit with no internal movement.
3. Name all the parts in the transmission and clutch.
4. Explain in detail the operation of the entire transmission and clutch, showing how reverse, low speed forward and high speed forward are obtained and give the reason for these results.
5. How do you reline the brake bands and what do you use for lining? And why does the Ford Company prefer to have you use lining free of metallic substance?
6. If a brake band slips, how do you correct the trouble?
7. If an improper kind of lining were used on the bands, say one containing metallic particles, what trouble will result in connection with the magneto action?
8. What lubricant is used to oil the disks of the clutch and how is it applied?

Lesson XVII.—Transmission and clutch control—Adjustment

A. Study:

Pagé, pages 198 to 202; also Ford Manual.

B. Practice:

1. With transmission in engine crank case, but with transmission cover removed, also bands removed, put bands on drums and then adjust brake bands, pedals and brake lever linkage and set screw and operate car by turning engine over by hand to see if you have slow speed forward with slow speed pedal down, neutral with slow speed pedal situated about in line with the reverse pedal, high speed with pedal all the way back (slow speed pedal) and all with brake lever fully down; also see if you have neutral with brake lever at neutral position, but without braking wheels. This proves the work.

C. Questions:

1. Explain how to adjust all pedals and hand brake lever and its linkage.
2. How do you proceed to assemble the bands of the three drums? In the event of their having been removed for relining?
3. If the car tends to jump forward slightly when cranking with brake lever in neutral what is the cause and how do you correct it?

Lesson XVIII.—Review of all chassis parts—Study of frame—Engine suspension—Adjustment of brakes, both foot and hand lever, by both shop and road methods

A. Study:

Pagé, pages 122 to 125, 204 to 208, 276 to 279, and 25 to 40; also Ford Manual.

B. Practice:

1. Use Ford car shop equipment "B."
2. Study all parts throughout the chassis; notice the manner of strengthening the frame; notice the three point suspension of engine.
3. Adjust both brakes in the following manner, first, the brake pedal should be forced down until about three-quarters of its total movement has been used, when it should lock the brake drum so as to hold the rear wheels tightly. This simply necessitates an adjustment of the brake band. Second, to adjust the hand lever brake adjust the adjustable clevis on the brake rods so that with a three-quarter movement of the brake lever the rear wheels will be tightly locked, then start with lighter brake pressures and try each rear wheel by hand to see if braking action on both is equal for the same position of brake lever. If not, adjust the brake rods to bring this about. This may take several successive adjustments. The adjustment of this brake may also be made on the road by running the car at a moderate rate of speed, using a somewhat soft road and applying the brake sufficiently to cause at least one of the wheels to lock. In this case there will be a mark on the road where the wheel locks, and by continuing to apply the brake the other wheel will likewise lock and begin to mark the road. The brake rods should be so adjusted before completing the work that both wheels lock with the same brake pressure and both marks begin on the road at the same point approximately.

C. Questions:

1. Why is it necessary that the brakes be in working or operative condition before leaving the garage?
2. How can you tell when the brakes need adjusting while driving the car?
3. How would you adjust the brakes? Explain in detail.
4. How should the brakes be used in order to avoid undue wear of tires and of mechanism?
5. When brake drums become scored what will be the result?
6. In the event of both the foot pedal brake and the hand lever brake not being in operative condition when one is going down a hill with the car still at a normal speed what other means of braking have you with the Ford car? (Not referring to the use of engine as a brake.)
7. How is engine used to relieve brakes in going down hills?
8. In the event of having the engine in high speed and engaged with spark off, at what speed is it safe to go into neutral?
9. Why does Ford engine have three point suspension? What are the merits of a three point suspension?
10. Make a sketch of the frame of the car, showing cross members, etc.

Lesson XIX.—Tires—Driving on road

A. Study:

Page, pages 165 to 178; also Ford Manual.

B. Practice:

1. In the case of the Ford car the regular equipment as to tires consists of a flexible band clincher type; this tire is forced over a solid clincher type rim, the flexibility of the band permitting of a slight stretching. The tire is likewise taken off by means of a tire iron. In the size of tire used with a Ford this is very satisfactory.
2. Tires should be considered as a very material part of the car, since tire cost, if tires are not properly taken care of, is a decided factor in the total expense of operating the car. Therefore, avoid running on the car tracks; running into the frog of the car tracks; running against the curb, which tends to wipe off that part of the tread of the shoe which is very thin, braking down the car suddenly so as to lock the wheels, causing the tire to skid along the ground; throwing the car around corners at an excessive rate of speed, which wears the tires sideways.

Tires should always be inflated to the pressure called for by the manufacturer. Do not attempt to secure spring action by means of soft tires. Tires should be tested for pressure every time one goes out with the car and in the event of a decided change in temperature or of running over hot roads at a high speed it may be best to test the tires for a possible increase of pressure due to expansion through heat, in which case let out the excess of air and put back when the tires become cool. Always use a gauge to test the pressure, such as the Schrader barrel gauge. Don't depend on kicking the tire nor using calipers nor watching the amount of tread contacting with the road. These means will always prove deceptive.

Outer shoe repairs should be taken care of by a tire repair man, except to use tire putty for small cuts or openings temporarily after cleaning out all foreign matter. Blow-out patches will get one home when the shoe is cut to such an extent as to permit of the inner tube projecting through. When replacing an inner tube in a shoe, always clean thoroughly and then cover the entire inner surface of the shoe with talcum powder. Inner tube repairs may be taken care of on the road when necessary and for this it is preferable to use the cement patch with a prepared fabric; such a patch is of the order of "Everlock." These patches can be made to hold and cover quite a long cut or fairly large puncture of the inner tube.

B. Practice—Continued.

3. Methods of driving should be acquired by personal instruction. The various suggestions as to driving found in the literature available will post one as to the theory of driving.

Traffic regulations should be obtained from the secretary of state and city traffic rules may be obtained through the police department. There are general practices common in all States, but city traffic rules vary as well as State laws. This pertains especially to lighting.

C. Questions:

1. Name the several parts that together make up what is called the shoe.
2. How would you look for a leak in an inner tube?
3. Describe the valve mechanism and valve insides.
4. How do you determine the pressure of air in a tire?
5. How do you apply a gasolene patch to the inner tube?
6. How do you vulcanize a vulcanizing patch to the inner tube?
7. How do you apply an ordinary piece of rubber with cement?
8. How do you apply a prepared cement patch?
9. What precautions do you take in replacing an inner tube?
10. What are the common practices generally in vogue throughout the country in connection with driving?

Lesson XX.—Trouble hunting

A. Study:

Pagé, pages 182 to 208; also Ford Manual.

B. Practice:

1. Use Ford car shop equipment "A."
2. Consider the trouble as belonging to some defective part in the engine system, since troubles having to do with parts outside the power plant of the car will probably be apparent by reason of an actual breakdown, a noise, knock or pounding, etc. Work out a standard system for locating trouble in the form of a chart. Make the basis of this chart the fact that troubles are likely to be of three kinds: (1) the fuel or gasolene feed system and carburetor; (2) compression, and (3) electrical. First, test for electrical trouble unless there is evidence of trouble in the other two classes. Do this by finding if current passes to the spark plug, in which case it will jump from the end of a secondary cable temporarily disconnected and held close to the spark plug. If the fault is not here, before testing the spark plugs it may be easier to find if gasolene is flowing to the carburetor. This being the case, it might be well to test for compression. If no indications develop then go through the trouble hunting methodically, first eliminating the electrical end by testing spark plugs.

C. Questions:

1. How will you determine the cause of engine stoppage in the event of its being electrical trouble? Give complete system of investigation.
2. In the event of its being gasolene trouble?
3. In the event of its being compression trouble?

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Unit Course—Auto Mechanics 3—Automobile Upkeep and Repair for Owners

AUTO MECHANICS

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is prepared primarily for the owner (present or prospective) of an automobile who expects to care for his own car. It is assumed that he has little or no experience in handling machines, and that he knows but little about the principles or operation of the automobile, but that he has sufficient general education to read with profit the references used in the lessons.

2. ADVANTAGES TO BE DERIVED BY THE STUDENT

It is intended that this course will familiarize the student with the various parts, mechanisms and principles of operation of the standard type of passenger automobile so that he can intelligently care for his car, including the lubrication, adjustment, and minor repairing necessary. By understanding the mechanical principles underlying the operation of the automobile the owner will derive the greatest amount of pleasure and satisfaction from the use of his car and will be able to secure a maximum of service with a minimum of expense.

NOTE.—This course does not apply to the Ford car. See Unit Course Auto Mechanics II for Upkeep and Repair of the Ford Car.

3. LENGTH OF THE COURSE

The work of this course is divided into 20 lessons, each intended to average from one to two hours of study and practice for the student.

The total work of the course should be completed in 30 hours.

4. EQUIPMENT AND MATERIALS

It is assumed that the school offering this course will provide sufficient equipment to give the pupil ample practice in studying disassembling, assembling, and adjusting of the various parts of the automobile. This equipment should include two or three automobiles of different standard types, in complete running order; two or three chasses with body removed and parts exposed as far as possible; several groups of the various integral units of the automobile representing the standard makes or types of each unit, mounted separately on stands or benches; e. g., there should be three or four engines of different types in the engine group, several different carburetors in the carburetor group, likewise a magneto group, a transmission group, etc. The student will thus find the particular make or type of unit which is contained in his own car, and for the purposes of this course he need study that one make or type only. It is assumed that the interests of the students taking this course will represent a greater variety of makes of cars than the school shop can be expected to possess, but by having a few of the standard types of the various units of the automobile each student can find for study practically all of the fundamental parts of his own car.

The equipment should also include the standard kits of tools furnished with each make of car, with such additions as the owner of moderate means would be likely to possess. It is not intended in this course to train specialists in automobile repairing, hence the student will not be called upon to use any special or unusual tools or appliances, even though the school shop may possess them for the work of other courses.

The school shop will furnish the commonly used automobile supplies such as oils, greases, cotter pins, lock washers, etc. The judgment of the instructor of the class will determine the necessary items.

5. MEASURING, RATING AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon-General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school and may take additional units in the second school.

It is, therefore, desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating shop work are available it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student showing results not up to the "fair" standard should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor, nor should this rating be influenced by personal feelings such as dislike or grudge. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

- (a) *Time*.—Is the student rapid, moderate, or slow in executing his work?
- (b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools?

(2) Finished product:

- (a) *Accuracy*.—Should be determined by the record kept of errors in measurement, omissions of dimensions or lines, etc.
- (b) *Quality*.—Consider the finished product in other respects than accuracy, such as finish, neatness, etc.
- (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson or is there still some deficiency that should be made up?

(3) Interest:

- (a) *Attitude toward work*.—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?
- (b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?
- (c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?

(4) Test problem:

A test problem might be given at the conclusion of the course which would involve all or most of the points covered by the course.

6. OUTLINE OF LESSONS

- (1) Getting acquainted with your car.
- (2) Care of tires.
- (3) Lubrication of chassis.
- (4) Adjustment of wheel bearings.
- (5) Adjustment of steering gear.
- (6) Adjustment of brakes.
- (7) The principles of the gas engine.
- (8) The engine internals—crank, pistons, etc.
- (9) The lubrication system of the engine.
- (10) The cooling system.
- (11) The valve system.
- (12) The carburetor and gasoline system.
- (13) The ignition system.
- (14) The starting system.
- (15) The lighting system.
- (16) The clutch.
- (17) The transmission.
- (18) The differential.
- (19) Trouble hunting.
- (20) Driving on the road.

7. BOOKS AND REFERENCES

The book recommended for study in connection with this course is: Hobbs and Elliott, the Gasoline Automobile, McGraw Hill Book Co., New York. References to this book are given with each lesson.

The student should also secure the manufacturers' instruction book for his own car. These books can usually be obtained without expense by writing to the manufacturer. The school should secure instruction books for several of the standard makes of cars. Many manufacturers also furnish other valuable material, such as oiling charts, likewise catalogues and descriptive literature of the various units of the car, such as carburetors, magnetos, electrical systems, tires, etc.

8. GENERAL DIRECTIONS TO TEACHERS

The lessons outlined for this course are designed to enable the student to work individually with a minimum of attention.

At the beginning of the lesson the instructor should go over the new assignment with the student, calling attention to difficulties that may be anticipated, seeing that the necessary materials are provided, etc. The instructor will be alert to the activity of the student while working out the lesson, accessible for help in answering questions that may arise, but should ever be mindful of the fundamental principles of pedagogy, namely, not to do for the student what the latter should do for himself. At the end of the lesson the instructor should check up the work of the lesson with the student and make sure that the essential points have been mastered.

Remembering that the purpose of this course is to enable the student to care for his own car, he should be urged at every step to follow the directions given in the instruction book published by the manufacturer of his particular car.

The instructor will recognize that the printed directions given in the student's lesson sheets or the references for study are not exhaustive. This information must be supplemented by the broader experience of the instructor. He will also realize that this unit course, written in broad terms to apply to the automobile in general, will naturally fail to mention many features of particular makes of cars. These points should be supplied by the instructor.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets, comprising Part 2 of this course, are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

INTRODUCTION

To the student:

This course is intended to familiarize you with the various mechanisms of your car and to teach you the fundamental principles of operation of the various parts. By learning these details you will enjoy greater pleasure and profit from the use of your car and will be able to obtain a maximum of service with a minimum of expense.

The lessons are planned to help you to pursue the course with but little attention from your instructor. He is with you for such assistance as you really need, but you should think twice and try to study out each question or solve each difficulty for yourself just as far as possible before requesting his help.

Before proceeding very far, you will learn that the care of an automobile requires time, effort, attention, and hard work. You must expect to get your hands greasy, and working clothes are very desirable. It is not a parlor job.

Lesson I.—Getting acquainted with your car

Study:

Hobbs and Elliott, *The Gasolene Automobile*, pages 1 to 24. Also, chassis chart in manufacturer's instruction book for your own car.

Practice:

1. Remove the hood over the engine. Locate the following parts, study carefully and determine as far as you can the purpose, operation, and connections of each: Radiator, water pump, oil pump, fan, carburetor, spark plugs, magneto, self-starter, distributor, valves, cylinders, crank case, vacuum feed, flywheel, exhaust manifold, oil intake, horn, tire pump. How many grease cups can you find?
2. Remove the footboards in front of the driver's seat. Locate and study the following: Clutch, transmission, clutch pedal, foot-brake pedal, emergency-brake lever, steering gear, storage battery, speedometer, universal joint, muffler. How many grease cups or oiling places can you find? Push down the clutch and brake pedals. Do they seem to work with reasonable freedom?
3. Examine the front axle. Locate and study the following:

Steering gear, springs, spring shackles:

- Study the device for turning the front wheels to steer the car, and trace the steering control back to the steering wheels. Why are spring shackles necessary? How many grease cups and oiling places can you find? What type of springs does your car have?
4. At the rear of the car locate the following: Gas tank, service or foot brake, emergency brake, differential, torque tube, strut rods, brake rods. How many grease cups or oiling places can you find?

Lesson II.—Care of tires

A. Study:

Hobbs and Elliott, pages 19 to 21, paragraphs 17 and 18.

Also pages 240 to 247 on "Care of tires."

Secure tire-repair instruction book from the manufacturer of the tires on your car, and study the contents carefully.

B. Practice:

Jack up each wheel in turn and examine carefully each tire for cuts, bruises, or pieces of glass, stone, or metal embedded in the casing. Remove all such foreign particles, cleanse the opening with gasolene and fill with mastic or some other preparation made for the purpose.

Test each tire for pressure, using a pressure gauge.

When a tire is unduly soft, remove it from the rim, take out the inner tube and examine carefully for punctures. When a puncture is found, patch the same with a cement patch. Directions for such patching are given with the packages of prepared patches sold by auto supply stores.

Never replace a tube in a shoe without examining the inner surface of the shoe for any particles of glass or metal that have worked through the casing and are liable to puncture the tube.

Replace the tube and remount tire on wheel according to directions from your instructor.

C. Questions for study:

1. How can you tell when a tire is properly inflated?
2. How can you tell while driving when the tube is losing air?
3. Why is tire talc or chalk used in the casing, and how should it be applied?
4. What are the objections to driving with an underinflated tire?
5. Why is a vulcanized patch better than a cemented one?
6. What is the danger from neglecting to repair puncture, gashes, or cuts in the casing?
7. What precaution should be taken with tires on a car in storage for the winter?
8. What is the effect of light, heat, and oil upon rubber, and how does this apply to the care of tires?
9. Which wheels require the stronger tires, and why?
10. What is the effect on the tires of driving on street-car tracks?
11. How does the application of brakes affect the tire?
12. What advantage is gained by shifting tires?
13. What is the relation between alignment of wheels and wear on the tires?
14. What is the correct inflation pressure for the tires of your car? How is it determined?

Lesson III.—Lubrication of chassis

A. Study:

Hobbs and Elliott, pages 103–106, paragraphs 74–79; page 113, paragraphs 84–85. Lubrication chart in instruction-book for your own car.

B. Practice:

1. Fill all grease cups. Start at one corner of the car, front or rear, and go all around, check on ruling chart each cup as you fill it in order to make sure that no cup has been omitted.
2. With squirt can filled with motor oil (medium cylinder oil), oil each place indicated on the chart for this kind of lubrication. Check each place on chart as before.
3. Make a record of lubrication. The following form will prove helpful. Remember that systematic lubrication will prolong the life of the car and enable it to render the best service.

NOTE.—The lubrication of the internal part of the engine will be taken up in another lesson.

Lubrication record

Part	Lubricant to be used	Speedometer reading	Lubricate again at following readings			
<i>Group A</i>						
Names of all parts to be lubricated every 100 miles or less.....						
<i>Group B</i>						
Names of all parts to be lubricated every 200 miles.....						
<i>Group C</i>						
Names of all parts to be lubricated every 300 miles.....						
<i>Group D</i>						
Names of all parts to be lubricated every 500 miles.....						
<i>Group E</i>						
Names of all parts to be lubricated every 1,000 miles.....						
<i>Group F</i>						
Names of all parts to be lubricated every 2,000 miles.....						

C. Questions for study:

1. Why do spring joints need lubricating?
2. Why is lubrication necessary between the leaves of the springs?
3. How should this lubricant be applied?
4. What is the special importance of lubrication in brake connections?
5. Are you sure that you have discovered every place in your car that needs lubrication?

Lesson IV.—Adjustment of wheel bearings

A. Study:

Hobbs and Elliott, pp. 8–10, The Front Axle.
 “ “ “ pp. 229, 230.

B. Practice:

1. Jack up front wheels, one at a time. When well clear of the ground, test for play by pushing in and out at the top of the wheel. If there is a shake, determine whether it is due to faulty adjustment of the wheel bearing or to wear in the steering knuckle joints.
2. Remove the wheel from the axle. Watch carefully the position of each nut, key, washer, bearing, etc., in order to replace in correct position.
3. Clean each part with gasoline or kerosene and inspect for cracks, chips or flaws.
4. Replace parts and pack with grease.

B. Practice—Continued.

5. Replace wheels and adjust. Follow directions as given in instruction book for your car.
6. Remove the rear wheels, clean parts, pack with grease, replace and adjust as for front wheel. Study carefully the difference in construction between front and rear wheel parts.

Questions:

1. What is the effect of sand or water on any ball or roller bearing?
2. What devices are used in your car to exclude dust and water from the wheel bearings?
3. What results are likely to follow from having the wheel bearings too loose? Too tight?
4. What should be done if bushings in steering knuckle joints are badly worn?
5. Is it necessary to remove the hub cap of the rear wheel in order to take off the wheel?

Lesson V.—Adjustment of steering gear

A. Study:

Hobbs and Elliott, pp. 10–12, The Steering Gear.

Section on steering gear in manufacturer's instruction book for your own car.

B. Practice:

1. Trace the operation and connection of each part of the steering gear from the steering wheel to the steering knuckles at the front wheel hubs.
2. Examine each joint for lost motion due to worn bushings or pins. When lost motion is found it should be taken up if any adjustment is provided. Worn parts such as bushings or pins should be replaced by new ones. These parts can be secured at the nearest service station for your make of car.
3. Be sure that every joint and moving part in the steering gear is properly lubricated.

C. Questions:

1. Name all the parts in front axle and steering gear that need lubrication.
2. Why are the steering knuckles of the front axle placed as close to the wheels as possible?
3. What attention is required at the point where the knuckle turns? How often?
4. What is the advantage of nonreversible type of steering gear?
5. What are disadvantages of it?
6. What is the advantage of a small amount of play in the steering wheel?

Lesson VI.—Adjustment of brakes

A. Study:

Hobbs and Elliott, pp. 16–18, 230, 163.

Section on brakes in instruction book for your own car.

B. Practice:

Adjust brakes. Jack rear axle up and determine whether there is too much play in rear wheels (see lesson 1). Inspect brake facings if brakes are of external type or are exposed to view.

Apply service-brake pedal a little at a time and try rear wheels alternately. Both should take hold at about the same time; one should be held about as tightly as the other, and when one is locked the other should not be free. When pedal is released both wheels should be free. When wheels are locked pedal should be not less than an inch from floor board or from lowest position to which it could be pushed.

Test hand brake the same way.

If brake facings are oily or greasy clean with kerosene.

If brake equalizers are provided they should stand nearly at right angles to the direction which the rod pulls them when the brakes are set.

If brakes are of internal expanding type and the levers on the brake-operating shafts on the rear axle are provided with an adjusting device designed to allow the angle of the lever with respect to the shaft to be changed, set pedal or hand lever in released position, loosen clamping nut, turn brake-operating shaft with pipe wrench until brakes are set, release just far enough to allow wheel to turn free and tighten clamp nut. Repeat on opposite wheel and then test for equality, as already directed.

B. Practice—Continued.

If brakes are of external contracting (or contracting band type) take up by means of adjusting nut on band and if necessary adjust jam nuts to give equal clearance between band and drum at top and bottom.

The importance of having brakes at all times properly adjusted and of having all yoke pins secured against loss by the use of cotter pins should not be overlooked.

C. Questions:

1. What may cause squeaking brakes?
2. How may the squeaking be remedied?
3. How may the engine be used to assist the brakes in going down hill?
4. How can you tell when brakes need adjusting?
5. What material is used in your brake linings?
6. How may the holding power of the brakes be increased besides by tightening the bands?

Lesson VII.—The principle of the gas engine

A. Study:

Hobbs and Elliott, The Gasolene Automobile, sections 21 to 26; also 32, 33, and 34.

If your car has the Knight type engine, study section 29; or if it has a rotary valve engine, study section 30.

Section on the motor in instruction book for your car.

B. Practice:

While cranking the engine by hand (with spark turned off) note sequence of valve action.

By observing action of one set of valves (either intake or exhaust) determine the firing, i. e., the order in which the explosions occur in the various cylinders.

Try the compression of each cylinder by cranking by hand with priming cocks of all other cylinders open.

With the engine running, open the priming cocks one at a time. Note the sound whether it is a distinct explosion or merely a hiss. Note whether a blue flame shoots out through the cock. Note whether the sound of the explosion is the same for each cylinder, or whether some cylinders seem weaker than others.

C. Questions:

1. Explain in detail the action of the four-cycle gasoline engine.
2. How may explosions occur during one revolution of the crank shaft in a four-cylinder engine?
3. How many in a six-cylinder engine?
4. What is the advantage of having the firing order 1-2-4-3 instead of 1-2-3-4?
5. What becomes of the burned gas after the explosion occurs?
6. When the exhaust valve begins to open, what is the position of the piston?
7. When the inlet valve begins to open, what is the position of the piston?
8. What should be the position of the piston when the spark occurs?
9. What is the advantage of the arrangement for advancing or retarding the spark?
10. What is the advantage of the six-cylinder over the four-cylinder engine?
11. How are the valves operated?
12. What is the advantage of compression?
13. How many causes for loss of compression can you discover?

Lesson VIII.—Internal parts of the engine—Crank, pistons, etc.

A. Study:

Hobbs and Elliott, The Gasolene Automobile, sections 41 and 42.

Also sections on the motor in the instruction book for your own car.

B. Practice:

Find in the school laboratory the engine of the same type as the one in your own car.

Remove the crank case if necessary in order to observe the operation of the crank, connecting rods, pistons, cam shaft.

Examine the connecting-rod bearings and test for lost motion or play due to wear or poor adjustment. If play is found, remove the cap and take out a thin layer of the shim, or if the shim is solid instead of being made up in thin layers, file off the flat surface in order to reduce the thickness enough to take up the play in the bearing.

B. Practice—Continued.

While the connecting rod is disconnected from the crank shaft, remove it and the piston from the cylinder. Examine the cylinder walls to see if they are scored.

Examine piston rings to see that they work free in grooves. Take out the old rings and insert new ones.

Note the construction of the cam shaft and the manner in which it operates the valves.

NOTE.—Leave the crank removed. You will need to study the internal part of the engine some more in the next lesson.

C. Questions:

1. Why are piston rings used?
2. What is meant by "piston slap" and how can it be overcome?
3. What are some evidences of a poorly fitting piston ring?
4. What are the evidences of play due to wear in crank bearings?
5. How many revolutions does the cam shaft make to each revolution of the crank shaft? Why?
6. What adjustments do you need to make on the cam shaft?
7. What is the purpose of the flywheel?
8. Of what material are the bearings made and why?

Lesson IX.—The lubrication system of the engine

A. Study:

Hobbs and Elliott, The Gasolene Automobile, sections 74 to 85.

Section on lubrication in instruction book for your own car.

B. Practice:

With the crank case removed as in the previous lesson, trace the circuit of oil from the oil pump to the sight gauge, through the distributor pipe to the splash trays.

Note the dippers on the connecting-rod caps and the method by which they splash the oil up into cylinders and pistons.

Note the oil-gauge device.

From a car that has run five hundred miles or more without renewing the oil, drain out the old oil from the crank case. Note the color and consistency of this oil compared with new oil. Flush the oil reservoir with kerosene and allow it to drain out thoroughly. Then fill the crank case with fresh oil.

C. Questions:

1. What are the results of running the engine without enough oil?
2. With too much oil?
3. Why does an old or worn engine consume more oil than a new one?
4. How can this be overcome?
5. How are the main crank bearings and connecting rod bearings oiled?
6. If the old oil drained out of the crank case is thinner than the original oil, what does it indicate?
7. How is the wrist pin oiled?
8. How are the timing gears oiled?
9. How can you determine the best kind of oil to use in the engine of your car?

Lesson X.—The cooling system

A. Study:

Hobbs and Elliot, sections 86, 87, 89. (For Franklin car read section 88.)

B. Practice:

Trace the circuit of the water in the cooling system, from the radiator through the pump, the cylinders, and back to the radiator.

Inspect all joints in water system, and if any leaks are found stop them by tightening up the joints, putting in new gaskets, sections of rubber hose, or any other thing necessary.

Examine the fan, see that the belt is tight enough to revolve the fan properly but not too tight. Keep fan bearing lubricated.

Drain the water out of the system, flush out with fresh water, and fill with clean water.

Caution: Water from wells is likely to contain lime which will in time form a crust and fill up small passages in the water system. Use soft water whenever possible.

C. Questions:

1. Why is a cooling system necessary?
2. What are the indications of overheating in the motor?
3. What are some causes of overheating in the motor?
4. What are the advantages and disadvantages of each system of cooling: Thermo syphon, forced circulation (pump), direct air cooling?
5. Which type of radiator does your car have: Tubular, cellular, honeycomb or plate? What are the advantages of this type?
6. Why does not the water jacket extend the full length of the cylinder?
7. What are the necessary properties of a satisfactory nonfreezing solution?
8. Which of the common nonfreezing solutions will you use in your car, and why?
9. Explain the purpose and action of a thermostat.

Lesson XI.—The valve system

A. Study:

Hobbs and Elliott, sections 26–28, 153.

Also section on valves in instruction book for your own car.

B. Practice:

1. Inspect the valve faces and seats. (To do this it will be necessary to remove cylinder head or valve caps, also the valve springs.)
2. Grind the valves, following directions given in references mentioned above.
3. Test the clearance between valve stem and push rod. Your instruction book will tell you how much clearance to allow. Pieces of paper of proper thickness will serve as gauges for this test. If the clearance should be between 0.003" and 0.004" find pieces of paper of these thicknesses (measured with a micrometer). Adjust the clearance so that the thinner piece will pass through the opening, but the thicker piece will not. Be sure that the lock nuts are turned up tight so that the adjusting screw can not turn with the running of the engine.
4. The carbon should be thoroughly removed from all surfaces of compression chamber by scraping.
5. Inspect the stems of the valves for wear which may cause noise. If there is too much play, a new valve with oversized stem may be put in, or if the valve guide is removable, it can be replaced by a new one. Examine the stems for perfect alignment. If they are sprung, new valves should be used.

C. Questions:

1. Why does the intake valve require less grinding than the exhaust valve?
2. Which valve (intake or exhaust) is subject to greatest wear on the stem, and why?
3. What is the necessity for clearance between the tappet and valve stem?
4. What is the result if this clearance is too great? Too small?
5. Should there be any difference between intake and exhaust valves in the amount of clearance?
6. What are poppet valves?
7. Why are they unnecessary in a Knight type of engine?
8. Why are they unnecessary in a two-cycle engine?
9. What are the indications of a leaky valve?
10. Is there any difference in the stiffness of the valve springs? Which set of valves should have the stronger springs and why?
11. In grinding valves how can you determine when you have a perfect fit?
12. What is the object of frequently lifting the valve and turning it to a different position during the process of grinding?

Lesson XII.—The carburetor and fuel-feed system

A. Study:

Hobbs and Elliott, sections 45 to 102.

Also instruction book for your own car.

B. Practice:

1. In the shop equipment, study the Schebler Model D carburetor, thoroughly understanding its construction and names of all its parts, by taking apart and reassembling. (NOTE.—The Model D Schebler is not properly an automobile carburetor, but is especially well suited to taking apart and demonstrating the fundamental principles.)

B. Practice—Continued.

2. Next study, disassemble, and reassemble the type of carburetor used on your own car.
3. Understand the means by which to adjust your carburetor after becoming fully acquainted with its construction as shown by the section model.
4. Adjust it for both low and high speed, then giving it the final adjustment that best takes care of the full range.
5. Study the construction and operation of the vacuum-feed tank.

C. Questions:

1. State exactly what the function of a carburetor is. Name all the parts of the carburetor. (Select one of the above group.)
2. What arrangement is supplied with a carburetor to permit of its working without a break in the flow of the mixture when the gas lever is suddenly moved, as when one wants a quick "get-a-way"?
3. What arrangement is sometimes furnished with a carburetor to permit of adjustment at the dash for altitude and climatic changes?
4. Why is heated air and sometimes hot water used to improve the operation of the carburetor?
5. What devices are arranged for the purpose of bringing heated air or hot water to the carburetor for warming purposes?
6. Explain in detail just how you adjust a carburetor to prevent too lean a mixture, too rich a mixture, and also to bring about a proper mixture for the various loads and speeds. Give indications of too rich a mixture, too lean a mixture.

Lesson XIII.—The ignition system

A. Study:

Hobbs and Elliott, Pages 127 to 151 for battery ignition.

Pages 153 to 178 for magneto ignition.

Also Instruction Book for your own car.

B. Practice:

For battery ignition—

1. First make a study of the battery system of ignition inclusive of battery coil, interrupter points, and distributor, with wiring, both primary and secondary cables.
2. Dismantle coil to understand thoroughly the action of the step-up coil which is used to increase the battery voltage to a pressure sufficient to jump the gap in the spark plug.
3. Note the means provided such as possibly a resistance coil on the step-up coil, to prevent an excessive flow of ignition current in the event of leaving the car with the ignition switch on, also used to equalize the flow of the current to take care of the requirements in the way of spark for the different speeds of the engine.
4. Wire up the battery system from beginning to end, having taken down all wiring after a thorough study of the same. Note that it is necessary to take into account the firing order of the cylinders in making the connections for the secondary cables from the distributor to the spark plug.

For magneto ignition—

1. Completely disassemble the Bosch magneto and understand thoroughly its make-up. Note that it consists of all the elements of the coil plus a means of generating primary current plus a means of interrupting and distributing the current.
2. Learn to time the magneto by making its gear connection to the engine in such a manner as to have the interrupter points break at the right point to give the spark with the spark lever fully retarded (on the sector of the wheel) just as the piston is leaving top dead center. Understand fully the method of completely timing the magneto in the sense of proving up the wiring from distributor, etc.

B. Practice—Continued.

For magnets ignition—Continued.

3. Note in connection with magnetism that the magneto already studied possesses permanent magnets and that there is a magnetic flux passing from the north to the south pole which is cut by the armature winding of the magneto, which in turn generates the low-tension current, which in turn induces a high-tension current on a secondary winding above the primary winding. Have the condenser action fully understood by working with and without a condenser. This affects the amount of spark at the spark-plug points and the sparking at the interrupter points.

C. Questions:

1. Define or explain the following terms: Volts, amperes, positive and negative poles, north and south poles, magnetic flux, neutral point, resistance to electricity, electric conductor, nonconductor, susceptibility to magnetism, nonsusceptibility, direct current, alternating current, short circuit, ground.
2. Give an idea as to the approximate pressure of voltage of the current leaving the primary winding and entering the secondary winding of either the coil or the magneto. Give the approximate voltage of the secondary circuit current as it is delivered to the spark plug.
3. What is a condenser, how made, and what is its function?
4. Explain how to set the interrupter points; how to clean them; how to square up their edges. What clearance should the interrupter points have?
5. How do you clean the breaker box containing the interrupter points on the magneto; also on the battery-system ignition; likewise how do you clean the commutator?
6. What cautions should be observed in cleaning and oiling the magneto?

Lesson XIV.—The starting system

A. Study:

Hobbs and Elliott, sections 179 to 211.

Also instruction book for your own car.

B. Practice:

1. Use shop equipment, Delco system, and Wagner two-unit system, or whatever may serve to show the single and double unit systems; likewise the several types of regulators and cut-outs.
2. Thoroughly study the action of the storage battery by using a demountable battery; and by testing a battery properly charged for voltage and for specific gravity. Understand just what is necessary to keep a battery so that its life will be prolonged so far as possible.
3. Completely disassemble the type of motor to be used, and understand the parts making up same and their functions. Try motor off of car by operating with battery.
4. Understand the different means by which motor is flexibly attached to the engine, to start engine.
5. Understand means of caring for motor, such as cleaning, oiling, and inspection.

C. Questions:

1. Name the parts involved in a complete starting system, neglecting to refer to such wiring as has to do with lighting.
2. Name the principle parts of a complete battery-starting and ignition system, and explain the use of each part; as principals you will have the storage battery, the motor, generator, step-up coil, interrupter, points, distributor; also accessory parts, such as cut-out, regulator, switch block, fuse block, etc.
3. What precaution should be taken when removing the storage battery from car? (As this varies with different types of installation, confine yourself to your own car.) What precaution should be taken when replacing storage battery?
4. How do you care for the motor and generator in the way of cleaning and oiling?
5. Describe complete timing and wiring of a battery ignition system.

C. Questions—Continued.

6. Give voltage of one cell of the commonly used type of storage battery when fully charged; also specific gravity reading; the same when discharged, so far as it is practical to have a cell discharge. The same for a battery which generally consists of three cells.
7. Give complete outline of your method of taking care of a storage battery under all conditions, such as, when driving, when in dead storage, and when used in cold weather.

Lesson XV.—The lighting system

A. Study:

Hobbs and Elliott, sections 179 to 211.
Also instruction book for your own car.

B. Practice:

1. Use shop equipment, such systems as will show single and double unit arrangements of generator and starting motor, with the several types of regulators and cut-outs, with car in operative condition, and, if possible, with a fuse or junction block, somewhat similar to that used with the Wagner system on the Studebaker car, which permits of tracing out lighting system wires in a very logical way.
2. Thoroughly study the complete system of wiring and make a diagram of same, Rewire by means of this diagram, having taken wires down after making diagram.
3. Study construction of the various lights, such as headlights, tail light, instrument light, etc.
4. Study the causes for nongenerating at the generator. Suggestive of these causes may be: Armature not revolving, brushes out of order, loose or dirty terminals, commutator not clean; next, generating but not charging battery; next, lights not burning, at least not properly; next, ammeter troubles.

C. Questions:

1. How do you determine when terminals are loose?
2. How do you determine an open circuit to battery?
3. How do you find a defective cut-out?
4. How do you find burnt-out bulbs?
5. How do you find the weak battery?
6. How do you locate burned fuses?
7. How do you locate grounded circuits? Or open circuits?

Lesson XVI.—The clutch

A. Study:

Hobbs and Elliott, pages 64 to 66.
Also instruction book for your own car.

B. Practice:

1. Use shop equipment, comprising cone clutch, multiple disc—wet type clutch, multiple disc—dry type, and place clutch, such as Borg & Beck. Other types being practically obsolete.
2. Note the construction of the cone clutch; understand how to replace a leather on a cone clutch; how to correct slipping and gripping with a cone clutch; how to make proper spring adjustment for cone clutch; how to properly lubricate thrust and and pilot bearing of a cone clutch, and how to operate a cone clutch to avoid undue wear of the leather facing and of the thrust bearing.
3. Study the other types of clutches, so as to understand thoroughly their action. With this multiple disc dry type clutch, thoroughly realize how easy it is to score the metallic parts through undue slipping of the clutch.

C. Questions:

1. Describe fully one type of clutch, naming all the parts and functions of same.
2. What do you do for a slipping clutch? What do you do for a gripping clutch; both with cone clutch type, multiple disc wet type, etc.?
3. Why is it bad to get into the habit of slipping the clutch instead of disengaging when driving?
4. How do you clean a multiple disc wet type clutch? With what do you relubricate it?
5. In driving, how should a clutch be engaged?
6. What is the function of a clutch, stated in brief and simple language?

Lesson XVII.—The transmission

A. Study:

Hobbs and Elliott, pages 66 to 69.

Also instruction book for your own car.

B. Practice.

1. Use shop equipment, comprising a transmission with geared arrangement and handle to operate same on a stand. Also have one or two transmissions on cars open to permit of the study of their action.
2. Understand, first, that the gear or speed ratio of the car refers to the ratio of the drive-shaft pinion and master or ring gear of the differential.
3. The transmissions largely in use are confined to those having three speeds forward and one reverse, and in consequence have the high speed directly connected to the clutch shaft or some part that is in turn connected directly to the engine crank-shaft, by means of some intervening device, such as the clutch. In high speed, therefore, no gears (with reference to the transmission) operate to affect the speed or power delivered at the rear axles.
4. Second and first speed are obtained through gearing to a jack shaft; for this reason we have the slight groaning sound that is the hum of the gears, when we do not operate the car in direct or high speed. The reverse is obtained by gearing to a third jack shaft; this gearing is also arranged as to give a greater pulling power at the rear axle as we go down in speeds, and on the other hand, to give a greater speed with less pulling power as we go up, bearing in mind, however, that the engine output is at all times the same. Illustrative of this we have slow speed of the rear wheels going up a hill with rapid speed of the rear wheels on the level, in both cases utilizing the full power of the engine, when we so wish it.

C. Questions.

1. Name the different types of transmission.
2. With the open gate gear shift lever arrangement, what is the length of travel for the gear shift lever working from neutral to first, from neutral to reverse, from neutral to second and from second to third, compared one with the other?
3. With the ball type gear shift lever, how do you find neutral and the other speeds when they are not marked on footboard plate?
4. What is the average speed at which you should go from first to second, from second to third, also from third to second and second to first?
5. Under what conditions do you operate the car in first?
6. Name all the parts and give an idea as to the location of the several shafts and gears making up one type of transmission. (Do this without seeing transmission.)
7. How would you lubricate a transmission gear set? What would you use for lubricant? How often would you clean and relubricate? What difference will it make as to the oil used in winter or summer?

Lesson XVIII.—The differential

A. Study.

Hobbs and Elliott, pages 70 to 71.

Also instruction book for your own car.

B. Practice.

1. Use shop equipment, comprising rear construction, complete, with drive shaft gear, arranged with crank handle to operate differential and with cover off differential.
2. Take down complete rear construction, noting the manner in which all parts are set up, and also having noted carefully the sound of the drive-shaft pinion as it operates the differential, so that when you readjust same you may know what adjustment will be right.
3. Carefully note the means for taking care of the radial and thrust load at the differential and adjustment of same, to bring the differential in the right position with regard to the drive-shaft pinion, so as to have nearly a full-face contact of the two gears; that is, the drive-shaft pinion and the ring gear of the differential. This adjustment should also result in as close as possible a setting of the two gears

B. Practice—Continued.

(ring gear and drive-shaft pinion), but a setting that will be free enough to take care of the high spots in either gear, eliminating all noise. When fully assembled there will still be a means of adjusting so as to throw the drive-shaft pinion further in on the differential ring gear, this arrangement being operable from the outside on the housing over the drive shaft near the drive-shaft pinion. This permits of adjustments for wear to great nicety.

C. Questions.

1. What is the purpose of the differential?
2. Describe in exact detail just how you adjust the differential and drive-shaft pinion from the outside.
3. Describe in detail just how you reassemble and adjust the differential and drive-shaft pinion; also the radial and thrust bearings.
4. Explain why the wheel on the right side, if held, and with the wheel on the left side turned and with the transmission in direct speed, the engine is caused to operate?
5. With what do you lubricate the differential? How often? How is it cleaned? How often?

Lesson XIX.—Trouble hunting

A. Study.

Hobbs and Elliott, sections 213 to 230.

Also instruction book for your own car.

B. Practice.

1. Use shop equipment, car in operating condition.
2. Consider the trouble as belonging to some defective part in the engine system, since troubles having to do with parts outside the power plant of the car will probably be apparent by reason of an actual breakdown, noise, knock, or pounding, easily located. Work out a standard system for locating trouble, in the form of a chart. Make the basis of this chart the fact that troubles are likely to be of three kinds: (1) The fuel or gasoline feed system and carburetor; (2) compression, and (3) electrical. First test for electrical trouble (unless there is evidence of trouble in the other two classes). Do this by finding if current passes to the spark plug (where the secondary cable connects) by holding the cable slightly, say $\frac{1}{16}$ " from insulated terminal of the spark plug. If current is going to the spark plug there will be a spark. If this is true, the fault is not here, although it may be in the spark plug itself. However, it will be easier first to find if gasoline is flowing through the carburetor and to test for compression before taking out spark plugs. If no indications develop, then go through with your trouble-hunting method methodically, first eliminating the electrical end by testing spark plugs.

C. Questions:

1. What can be causes for electrical trouble in connection with the ignition system? Name all.
2. What can be causes of trouble with the gasoline or fuel feed system, inclusive of carburetor? Name all.
3. What are possible causes for troubles due to loss of compression? Name all. In the event of engine stoppage, give your system for investigating the electrical system so far as it applies to ignition.
4. Give your system for investigating gasoline or fuel feed system troubles.
5. Give your system for complete investigation of loss of compression trouble.

Lesson XX.—Driving on the road

A. Study:

Hobbs and Elliott, sections 231 to 253.

Also instruction book for your own car.

B. Practice:

1. Use shop equipment car in operating condition for road.

B. Practice—Continued.

2. See that four points are taken care of always before leaving garage, e. g., (1) have plenty of lubricating oil in engine crank case; or if force-feed system, in oil-storage tank; (2) see that there is plenty of water in radiator, practically up to the top of the overflow pipe; (3) see that there is sufficient gasoline; (4) see that tires are inflated to the pressure called for by the manufacturer and measured by the use of a gauge.
3. Obtain traffic regulations from the secretary of state and city traffic rules from the police department.
4. Understand the general practices employed in connection with driving.

C. Questions:

1. At about what speed will you turn a corner, with reference only to the saving of tires?
2. Why is it not best to soften the tires a little by lowering the pressure with a view to easier riding?
3. Name the rules applying to the general practice of driving.
4. Name the principal means by which you can save the tires through proper manipulation of the car and brakes.
5. Name the principal rules that you must observe in connection with the State (in which you are to drive) traffic regulations. Likewise, city regulations.
6. How do you take the descent of a long steep hill to avoid undue heating of brakes?
7. If car starts down hill and is getting out of control, what would you do?

Rehabilitation monograph. Joint Series No. 61.

Unit Course—Auto Mechanics 4—Engine Repairing—Section II

AUTO MECHANICS

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENT

This course is designed for the student who has completed the preceding unit course on engine repairing and has shown himself adapted to the work.

2. AIMS OF THE COURSE

- (a) To give the student additional practice in the repair of the automobile engine.
- (b) To develop by practice his ability to locate various troubles that are common to all gasoline engines.
- (c) To develop men who desire to enter this line of work with an honest desire to do work that will give satisfaction.

3. LENGTH OF THE COURSE

This course is intended to cover about 30 hours of practice and study, and the student should be encouraged to do considerable reference reading outside of his regular classroom hours.

4. OUTLINE OF LESSONS

The following exercises should be given with the understanding that quality of work rather than quantity is desired:

- I. Marking the timing gears and flywheel.
- II. Removal and repair of the crank shaft.
- III. Removal and repair of the cam shaft.
- IV. Repair of main bearings.
- V. Repair of connecting-rod bearings.
- VI. Assembling the engine.

GENERAL SUGGESTIONS TO THE TEACHER

In addition to the suggestions in unit course, Auto Mechanics 1, the following are offered:

- (1) It is understood that the student has completed the first unit of this course and has acquired a good knowledge of the tools needed in this class of work, but it is necessary that the teacher watch the student to see that he does not become careless in his selection of tools used.
- (2) Before allowing students to attempt a new piece of work be sure that they fully appreciate the necessity for doing it and that they understand the results that may be expected.
- (3) Insist on quality rather than quantity. It is better to have a student scrape one bearing right than a dozen that are nearly right.
- (4) Insist that all engine parts be put in a box or pan provided for them, and that all tools are kept in good order.

SUGGESTIONS FOR TEACHING LESSON I

- (1) Explain the system of timing gears used, also the gear ratio and direction of rotation of the various shafts with relation to the crank shaft.
- (2) Explain the use of protractor in laying off the various points on flywheel and explain why this is necessary.
- (3) Show how a set of timing gears should be marked to insure the proper setting when engine is assembled.
- (4) Discuss the effect of worn timing gear on the valve action.

SUGGESTIONS FOR TEACHING LESSON II

- (1) Explain the method of finding loose main bearing by use of jack.
- (2) Explain various crank shaft construction.
- (3) Demonstrate how a crank shaft is removed.
- (4) Caution student about handling crank shaft.
- (5) Show how a shaft may be smoothed up by the use of emery cloth.
- (6) Explain and demonstrate how a shaft can be tested for straightness, etc.

SUGGESTIONS FOR TEACHING LESSON III

- (1) Explain the construction of the cam shaft (solid and built-up types).
- (2) Demonstrate how shaft is tested for straightness.
- (3) Show effect of cam wear on lift of valve, and why it is necessary to replace a cam shaft if cams are worn.
- (4) Explain how the cam shaft determines the firing order of engine; and call attention to the fact that it is impossible to change firing order without using a different cam shaft.

SUGGESTIONS FOR TEACHING LESSON IV

- (1) In fitting and repairing main bearing it is necessary to require that the student keep scrapers and tools used in good condition.
- (2) Demonstrate the use of Prussian blue and caution student about using too much.
- (3) See that student works all bearings down together and that he removes metal slowly.
- (4) Insist that each student stick to this work until a good job is turned out.

SUGGESTIONS FOR TEACHING LESSON V

- (1) The work is similar to Lesson IV and should be continued until student can do a good job. Practice is the only means for becoming expert at bearing fitting.
- (2) Show how piston and connecting rod assembly is tested for alignment.

SUGGESTIONS FOR TEACHING LESSON VI

- (1) Follow the work of student and see that all lock washers, cotter pins, etc., are put in where necessary.
- (2) Be sure all parts are well oiled before assembling.
- (3) Inspect timing of engine to make sure timing gears are meshed correctly.
- (4) See that oil and water are supplied, and operate motor under its own power if possible. Run slowly at first, as it takes some time for oil to get worked into all bearings.

6. MEASURING, RATING, AND RECORDING STUDENT'S WORK

See this section in teacher's manual for unit course, Auto Mechanics 1, Engine Repairing, Section I.

7. REFERENCE BOOKS

The same reference books are used in this course as in the unit course above mentioned.

8. EQUIPMENT AND MATERIAL

In addition to the list given for the unit course above mentioned, the following are necessary for this course:

- 6 Bearing scrapers.
- 2 Tubes Prussian blue.

PART 2. STUDENT'S INSTRUCTION SHEETS

INTRODUCTION

This unit course is a continuation of the preceding course on repairing the automobile engine. Before proceeding with this course, the student is requested to review the General Instructions which introduced the former course.

Lesson I

Problem: Marking the timing gear and flywheel:

Apparatus: Engine; necessary tools to be obtained from tool room as needed.

Procedure: Remove timing gear cover plate and note the marking of the timing gears that drive the cam shaft, magneto, or distributor. (The marking is different on various engines.) Dyke, page 106.

Locate piston No. 1 on top dead center and locate the mark on flywheel that would indicate that No. 1 piston should be on top dead center. If the position of the piston and mark on flywheel agree, it is possible to use the flywheel marking as a guide in setting engine. Dyke, pages 106 and 107.

If flywheel or timing gears are not marked, determine correct setting for engine and mark top center of piston on flywheel and also exhaust-valve closing. Dyke, page 107. Mark timing gears.

Lesson II

Problem: Removal and repair of crank shaft:

Apparatus: As in Lesson I.

Procedure: Determine the construction of crank case and if crank shaft is loose in the main bearings. Dyke, page 647. How to determine where, No. 5.

If bearings show play, it is necessary to tighten or replace, depending on condition.

Remove crank shaft from engine. (It may be necessary to turn engine over and let it rest on cylinder top.) Dyke, page 648.

Test crank shaft for bend. Dyke, page 646. Figures 2 and 5 (read carefully).

Inspect crank shaft carefully, and if rough or worn, repair. Dyke, page 642, Figure 1. Care should be taken with a long crank shaft that it is not bent or marred in handling.

Lesson III

Problem: Removal and repair of cam shaft:

Apparatus: As in Lesson II.

Procedure: Remove cam shaft. Test for straightness. Inspect bearing for wear. Inspect cams for wear. (If cams are worn, it is necessary to install a new cam shaft.)

Note the arrangement of the cams and how they determine the firing order of the engine.

Lesson IV

Problem: Repair of main bearings:

Apparatus: As in Lesson I.

Procedure: In the repair of bearings it is necessary to have a great amount of patience, as the work is more a matter of time and patience than of mechanical ability.

Proceed with work as shown by Dyke, pages 640, 641, and 642.

Lesson V

Problem: Repair of connecting-rod bearings:

Apparatus: As in Lesson IV.

Procedure: (1) Test connecting rod on piston No. 1 and if found loose, remove shims till fairly tight. Remove all oil from shaft and bearing and coat shaft very lightly with Prussian blue and test bearing; if found to have a poor bearing, scrape to fit. Dyke, pages 640, 641, 642, 643.

Test piston for alignment when you have finished fitting bearing. Dyke, page 646.

Lesson VI

Problem: Assembling the engine:

Apparatus: As in Lesson V.

Procedure: Clean and oil each part before assembling. Care must be taken that each and every part is in its proper place.

See that all lock nuts and cotter pins are replaced.

Have teacher O. K. the work as you proceed, and if in doubt ask teacher.

For any special points see Dyke. (Look up in index for any point not clear.)

See that oiling system is O. K.

If possible when completely assembled, start motor and run slowly for some time, being sure plenty of oil and water is supplied.

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Unit Course—Bookkeeping 3.—Farm Receipts and Expenditures in Single Entry

BOOKKEEPING

February 1919, Trial edition

PART 1. TEACHER'S MANUAL

1. QUALIFICATIONS OF STUDENTS

This course is intended for pupils with the following qualifications:

1. Ability to write legibly.
2. Ability to make computations in the fundamental operations in arithmetic.
3. Ability to read and understand simple business language.
4. An interest in farm activities.
5. A desire to know how to record the financial operations of a farm.

2. AIM OF COURSE FOR STUDENTS

This course is intended:

1. To create an interest in the application of business methods to the business of farming.
2. To train the student to make simple records for farm transactions.
3. To understand the results exhibited by the records.

3. LENGTH OF THE COURSE

This unit course is divided into two parts. There are five lessons in part 1 and five lessons in part 2. About one hour should be given to each lesson. Total, 10 hours.

4. EQUIPMENT

Paper: Standard double sheet journal paper with unit ruling, four double sheets. Standard single sheet ledger paper with unit ruling, two sheets. White ruled paper, about 8 by 10 inches, two or three sheets.

Pens and ink: Use pen and ink if possible.

Ruler: 12-inch.

Table: A writing surface of some kind. A table or drawing board.

5. METHOD

Have the student read over lesson 1, and then determine whether or not he understands what the statements contained in the lesson mean. Be sure that he understands what the transactions mean.

Student should not erase records. Rule line through errors and rewrite above the error or in the proper place.

The text matter will guide the average student. Observe the work and assist by questions where necessary.

Use black ink or pencil for ruling.

The review sheets are intended for tests. Use these, or similar questions and problems.

In determining farm profits, cash withdrawn for living expense, upkeep of house and furnishings, insurance on house, farm produce consumed in house, should not be treated as farm expenses.

Interest on capital invested is a proper expense charge, but this item is not considered in unit 1.

Some explanation may be necessary to clear up the transactions with a debtor and a creditor in part 2.

In part 2 the form of a check and stub might be shown. The commercial bank, and the depositor, will be taken up in unit 2.

Omit entirely the use of the second money column on each side of the page when making the cash records and when totaling and ruling. Do not balance the records for each month. This will be taken up later. Follow the model.

The most difficult problem in this unit will be to distinguish between cash receipts and farm income when the two do not coincide, and cash payments and farm expense.

6. MEASURING, RATING, AND RECORDING STUDENTS' WORK

Upon the completion of this unit course, the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating students' work in bookkeeping are available, it is recommended that the final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in business practice should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following points in arriving at the rating for the work of this course:

1. Require good form and complete explanation, including date in connection with records.

2. The student should be able to determine the net farm income in each of the review lessons. He should be able to distinguish between farm income and cash receipts that are not farm income.

3. He should be able to distinguish between farm expense and cash payments that are not farm expense.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

LESSON 1

Fred Manning owns a small farm consisting of 100 acres. His dairy is his principal source of income.

His business is all conducted on a cash basis. All sales are for cash and all expenses are paid in cash as soon as bills are received.

The milk from the dairy is delivered at a local cheese factory and a check is received on the 5th of the following month for milk delivered the preceding month.

Transactions for the month of January, 1917, will be given and you will make a record of all cash received and all cash paid.

Follow the form of the following model:

CASH RECEIPTS AND PAYMENTS.—A. D. Jones, farm

RECEIPTS			PAYMENTS		
1917			1917		
Jan. 1	Sold Brown 2 pigs.....	10.00	Jan. 2	Lane's bill, lumber.....	8.00
2	Sold 4 tons hay.....	60.00	4	Blacksmith bill.....	6.00
8	Sold 1 ton straw.....	7.50	6	Fox's feed bill.....	20.00
19	Milk check for December.....	100.00	12	Groceries.....	30.00
26	Sold Fox 2 calves.....	6.00	17	Farm hand.....	35.00
31	Sold Fry 1 hog.....	29.00	23	2 hay forks.....	1.50
			30	Repairing harness.....	2.00
			31	Farm hand.....	35.00
	Forwarded.....	212.50		Forwarded.....	137.50

Cash receipts and payments.—A. D. Jones, farm

RECEIPTS			PAYMENTS		
1917			1917		
Feb. 1	Total receipts for January, forward....	212.50	Feb. 1	Total payments for January, forward..	137.50

Read the transactions in lesson 2 carefully, then study the model cash record of A. D. Jones.

After you have made a study of the model, determine what record you should make for the first transaction and then compare your decision with the model. Go through all of Manning's records in this way.

Your second lesson will be to write Manning's record. These records should include the date, a full statement of the transaction and the amount.

LESSON 2

The following are the transactions you are to record for Fred Manning:

Jan. 1, 1917. Sold Fred Smith 2 calves for cash.....	\$5. 00
Jan. 2, 1917. Paid cash for repairing harness.....	1. 50
Jan. 3, 1917. Sold Benson 1 calf for cash.....	2. 50
Jan. 4, 1917. Sold 2 dozen eggs for cash.....	1. 00
Jan. 5, 1917. Received check for December milk.....	110. 00
Jan. 6, 1917. Paid land tax in cash.....	75. 00
Jan. 8, 1917. Paid cash for feed.....	10. 00
Jan. 10, 1917. Paid blacksmith bill in cash.....	3. 00
Jan. 12, 1917. Sold 10 bushels potatoes for cash.....	10. 00
Jan. 13, 1917. Paid cash for groceries.....	20. 00
Jan. 15, 1917. Sold (1 ton hay, \$20; 1 ton straw, \$8) for cash....	28. 00
Jan. 16, 1917. Sold 1 hog for cash.....	30. 00
Jan. 17, 1917. Sold 3 calves for cash.....	11. 00
Jan. 18, 1917. Sold 3 dozen eggs for cash.....	1. 50
Jan. 19, 1917. Paid farm hand cash.....	30. 00
Jan. 20, 1917. Paid cash for feed.....	20. 00
Jan. 22, 1917. Paid cash for clothing.....	15. 00
Jan. 23, 1917. Sold for cash 10 tons hay.....	200. 00
Jan. 25, 1917. Paid school tax in cash.....	30. 00
Jan. 26, 1917. Paid fire insurance premium on barns.....	32. 00
Jan. 29, 1917. Paid grocery bill in cash.....	30. 00
Jan. 31, 1917. Paid farm hand in cash.....	30. 00

LESSON 3

Answer all questions and make all computations that follow concerning the January records on the lower one-half of the double sheet used for January. Number your answers as the questions are numbered. Do not copy the questions.

Total the cash receipts for the month of January.

Total the cash payments.

1. Find the difference. 2. How much cash should Manning have January 31? Three items in the cash payments are not farm expense. 3. Name these items. Rule the pages like the model and forward the totals to another double sheet, using the first line on each side as follows:

February 1, 1917 (left-hand page): Total receipts for January brought forward.

February 1, 1917 (right-hand page): Total payments for January brought forward.

Put a heading at the top of the double page the same as you did for January, except the month, which is "February."

We can not determine from the January records whether Manning will make a good profit or suffer a loss for the year. 4. Why not? Use January sheet for answer.

Using the double sheet which you headed "February 1, 1917," and on which you entered the totals for January, record the following:

Feb. 2. Paid bill for clothing for wife and self.....	\$30. 00
Feb. 3. Paid for farm paper.....	2. 00
Feb. 4. Paid railway fare (a business trip).....	10. 00
Feb. 5. Received check for January milk.....	160. 00
Feb. 5. Paid for repairing sleigh.....	5. 00
Feb. 6. Paid for feed.....	20. 00
Feb. 10. Sold 2 calves for cash.....	6. 50
Feb. 11. Sold 20 bushels oats for cash.....	14. 00
Feb. 12. Paid grocery bills.....	15. 00
Feb. 15. Sold 2 dozen eggs for cash.....	. 90
Feb. 18. Sold 1 hog for cash.....	27. 00
Feb. 20. Paid for 1 pig.....	3. 00
Feb. 22. Paid for feed.....	15. 00
Feb. 25. Sold 5 bushels potatoes for cash.....	6. 50
Feb. 28. Paid for tools for workshop.....	10. 00

LESSON 4

Total the February cash receipts and include the January total brought forward. Total the payments and include the January total brought forward.

Rule the February cash record the same as you did in January, and carry the total down six lines under date of March 1, 1917.

Instead of giving the transactions for March and the remaining months of the year, the totals only for the balance of the year will be given. Enter these on the sheet below the totals dated March 1, but date these records December 31:

Sales, hay, grain, and stock for cash.....	\$400
Checks received for milk.....	2, 500
Payments for feed, repairs, and blacksmith's bills.....	900
Payments for living expenses, clothing, and entertainment.....	800
Payment for farm hand and other help.....	850
Payments for war and charity contributions.....	30
Payment for two Liberty bonds.....	200
Received cash net from a deceased uncle's estate.....	1, 000

Total the cash receipts and total the cash payments.

Answer the questions that follow and make your computations on the lower third of the double sheet. Number your answers as the questions are numbered. Do not copy the questions.

1. How much cash should Manning have at the end of the year? (We will assume that the farm inventory consisting of equipment, unsold produce and the milk check for the current December are equal to the conditions that existed January 1. Then the cash receipts from the farm for the year, less the payments on account of farm expenses for the year, should give the net farm profit for the year.) From the total cash receipts, take the cash item that was not received from the farm.

2. What will this remainder represent? From the total cash payments, take the payments that were not made for farm expenses. There are three payments in January, one in February, and two dated December 31 that are not farm expenses. Regard the charity payment as a farm expense.

3. What will this remainder represent? From the result you now have, find the net farm income.

LESSON 5

Use a single page of journal paper.

Review questions

1. Give two illustrations each of farm income and farm expense.
2. Give an illustration of a cash receipt that is not farm income.
3. Give an illustration of a cash payment that is not a farm expense.
4. Distinguish between income and cash receipts.
5. Distinguish between payments and expenses.
6. Should the living expense of the proprietor or owner of the farm be regarded as a farm expense?
7. The financial activities of a farmer for the year were as follows:

Sales (all cash) of farm produce.....	\$4, 500
Sale of 10 shares of railway stock for cash.....	800
Total cash payments.....	4, 700

The cash payment included the payment of living expenses, \$1,200, and the purchase of investments, \$1,000.

- (a) Determine the amount of cash on hand at the end of the year.
- (b) Determine the net farm profit.

LESSON 6

John Williams owns and operates a farm located near a village in northern New York. The farm consists of 250 acres, valued at \$60 an acre. The value covers all buildings, including a house and its furnishings. Williams employs two men, who live in their own homes near by. He pays each man \$80 a month throughout the year. The value of farm machinery,

horses, cattle, produce on hand January 1, 1927, is \$3,800. The principal source of income from the farm is the dairy. The milk is sold to a New York City dealer, 325 miles away, and is delivered to a local milk station daily. A considerable amount of hay and oats in excess of what is consumed on the farm is sold to a local hay and grain dealer.

The average cow produces milk about nine months in the year. The production of milk is cheaper in summer than winter, but the fall, winter, and spring price is much higher, and Mr. Williams has arranged his milking season for a large part of his dairy accordingly. The milk for each month is paid for by check on the 15th of the following month.

Practically all of Mr. Williams's business is on a cash basis. He owns all the above property free from debt and has a cash balance in a local bank of \$500. Practically all the money received is deposited in the bank, and practically all payments are made by check.

The sales (income) and expenses of the farm for the month of January follow. These transactions are all cash except as noted in particular cases. Read over these transactions to get a general idea of what has taken place on Mr. Williams's farm for the month. Then record the January cash receipts and payments in the same way you did with Fred Manning's business:

Jan. 1.	Cash balance in bank (enter this balance on the first line under cash receipts dated Jan. 1)	\$500. 00
(Mr. Williams keeps his cash in two places, a small amount on hand and the balance at the local bank. A few of the small payments are made in currency. All other payments are made by check. As currency and checks are received, deposits are made in the bank. No reference is made in the list of transactions about deposits in the bank or drawing checks. You will assume that such deposits are made and that payments are made by check.)		
Jan. 2.	Bought for cash, 1 ton feed	60. 00
Jan. 3.	Paid blacksmith bills	5. 50
Jan. 4.	Sold 4 calves for cash	40. 00
Jan. 5.	Bought 6 pigs for cash	15. 00
Jan. 6.	Sold 100 bushels oats for cash	70. 00
Jan. 8.	Bought for cash $\frac{1}{2}$ ton feed	25. 00
Jan. 10.	Sold for cash 1 hog	32. 00
Jan. 12.	Bought lumber and cement of Dale Bros. to be paid for in 60 days, to make repairs in barn	450. 00
NOTE.—This item is not a cash payment. The amount is owing to Dale Bros. People whom we owe are our creditors. When we become indebted to them we indicate that fact by keeping an account with them as follows:		
	Dale Bros: Jan. 12, 1917. Lumber and cement	450. 00
Later, when we pay Dale Bros., we enter the amount on the left side of the account. The method of subtracting in book-keeping is by entering the amount on the opposite side of the account. Use a single sheet of ledger paper and open an account with Dale Bros. and make the record.		
Jan. 15.	Received check for December milk	200. 00
Jan. 16.	Paid farm hands cash	80. 00
Jan. 18.	Paid cash for labor in repairing barns	100. 00
Jan. 22.	Sold 20 tons hay for cash	400. 00

LESSON 7

(Williams's records—continued)

Jan. 23.	Paid for groceries	\$40. 00
Jan. 24.	Sold J. B. Stevens 6 tons straw, to be paid for in three months ..	50. 00

NOTE.—Cash was not received at this time for this item. Mr. Stevens owes for the amount and becomes our debtor. When people become our debtors we indicate that fact by keeping an account with them as follows:

J. B. Stevens: Jan. 24, 1917. 6 tons straw	50. 00
--------------------------------------------------	--------

Later, when Stevens pays, we enter the amount on the right side of the account. Use the reverse side of the ledger sheet and open an account with J. B. Stevens and enter the amount.

Jan. 26,	Paid for family expenses and entertainment.....	\$15. 00
Jan. 28,	Paid bill for household goods.....	100. 00
Jan. 31,	Paid farm hands cash.....	80. 00

Total the cash receipts. Total the cash payments.

Answer questions and make computations on the lower third of the double sheet.

Number your answers.

1. Are all cash receipts for the month farm income?
2. What other item of farm income is there?
3. Are all cash payments for the month farm expense?
4. Determine which are not.
5. What other item of farm expense not listed in the cash payments is there?

Rule your January cash record the same as you did the Fred Manning record, and carry the totals about six lines below on the same sheet. Enter these totals on the same level. Place a heading above the total you have carried down, dated February 1, 1917.

LESSON 8

(John Williams's records—Continued)

With a few exceptions, the transactions for the balance of the year will be given in totals. Enter the cash item under the February heading, but use the dates indicated. Enter the two noncash items in their respective accounts, under date of December 31.

Dec. 31.	Sale of milk for cash.....	\$4, 000. 00
	Payment in cash for feed, additional repairs, etc.....	1, 200. 00
	Received cash from J. B. Stevens for straw sold in January, (enter in cash record and in Stevens account).....	50. 00
	Payment in cash to Dale Bros. for lumber and cement bill, bought in January (enter in cash record and in Dale Bros.' account).....	450. 00
	Payment in cash for farm hands.....	1, 760. 00
	Payment for three Liberty bonds.....	300. 00
	Payments for war and charity contributions.....	50. 00
	Payments for living expenses and clothing.....	1, 200. 00
	Sale of hay, grain, and stock for cash.....	1, 100. 00
	Sale of produce to John Norman, to be paid for in 2 months. (This is not a cash record. Open an ac- count with Norman on the ledger sheet below the account with J. B. Stevens).....	300. 00
	Purchase of shingles from W. A. Moore, to be paid for in 2 months. (This is not a cash payment. Open an account with Moore on the ledger sheet below Dale Bros.).....	350. 00

Total the cash receipts. Total the cash payments.

Double rule below these totals.

LESSON 9

(John Williams's records—Continued)

How much cash should Williams have at the end of the year?

Assume the produce on hand, the horses, cattle, machinery and equipment, and the amount due for milk produced in December are the same in total as these items were on January 1st.

Determine the cash receipts from the farm for the year.

Should the \$500 on hand at the beginning of the year be included?

Add to the net farm cash receipts the sale to John Norman. This total will give the total farm income for the year.

From the total cash payment, deduct the payments that were not for farm expenses. Add to the remainder the amount you owe Moore for shingles. These shingles were used to repair barns. This sum is the farm expense for the year. Now determine the net farm profits for the year.

LESSON 10.—REVIEW

1. Give an illustration of a transaction representing farm income in which no cash is received.

2. Give an illustration of an item of farm expense in which there is no cash payment.

3. Illustrate a cash receipt that is not income.

4. Illustrate a cash payment that is not farm expense.

5. Determine the net farm profit for the year from the following:

Cash on hand January 1	\$400.00
Sales for cash	6,000.00
Sales that have not been paid for Dec. 31	700.00
Cash payments total	5,300.00

The above payments include the purchase of five shares of railway stock at a total cost of \$500.

6. Determine the cash balance at the end of the year.

Rehabilitation monograph.—Joint Series No. 63

Unit Course—Bookkeeping 4.—Farm Accounts and Inventory

BOOKKEEPING

February, 1919.—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENTS

The same as for unit 1, and the satisfactory completion of unit 1 or the completion of a course in elementary bookkeeping.

2. AIM OF COURSE FOR STUDENTS

1. To teach the student how to keep accounts as follows:

(a) Cash account.

(b) Farm account the debit side of which is to represent farm expenses and all farm property purchased and interest cost, and the credit side to represent sales of all farm produce or property, including produce used in the home and interest income.

(c) Debtors' accounts.

(d) Creditors' accounts.

(e) Notes receivable account.

(f) Notes payable account.

(g) Withdrawal account.

2. To teach the meaning of:

(a) Farm inventory and how to prepare the farm inventory.

(b) Assets.

(c) Liabilities.

(d) Net capital at beginning.

(e) Withdrawals for home or other use.

(f) Net capital at beginning less withdrawals.

(g) Two methods of determining net profit.

3. To teach a system of farm bookkeeping from which an income-tax report can be conveniently made.

3. LENGTH OF THE COURSE

Eighteen to twenty hours.

4. EQUIPMENT

Paper: 8 standard double sheets journal paper with unit ruling; 12 standard small sheets ledger paper with unit ruling, and 6 sheets white ruled paper about 8 by 10 inches.

Pens and ink: All work should be done in ink.

Ruler: 12-inch.

Table.

5. METHOD

The text matter up to lesson 7 presents very definite questions to the student.

Give some assistance in arrangement of work on sheets.

Explain meaning of terms and question the student on their meaning.

Observe the work as it is done and correct errors as soon as they are made, if possible.

Do not allow the student to get hopelessly confused and become discouraged. Better do considerable of the work for him if necessary in the first three problems; not the actual recording, but guide him in details.

The ability to prove the work by obtaining the net profit by two methods should create intense interest in the work.

Lessons 7, 8, and 9 on business papers are presented to give the student models. Give the student a set of facts from which to prepare an invoice with the model before him, then another set of facts to prepare the form without the model. Cover the receipt, check, note, and draft in the same way.

Question the student on how to open a bank account and how to indorse (two forms) checks, notes, and drafts.

Several forms of drafts are given. Do not attempt to teach all these forms. These forms are given in the text more for the purpose of reference, for use, perhaps years later. It is assumed the student will be permitted to retain a copy of the text.

The rules for recording checks and notes in lesson 9 should be learned.

The draft as a note payable or note receivable in the records should not be emphasized in this brief course.

In lessons 10 to 16 considerable help is given in the text. Watch the process of the recording.

In lesson 15 the records are continued through a second year. At the beginning of the second year new accounts are to be opened with cash, farm, and withdrawals. The cash balance for the previous year should be entered in the cash account. Do not carry any balance forward in the farm or the withdrawal account. Debtors, creditors, notes receivable, notes payable accounts should be continued.

This unit is intended to cover records for the farm business. Other outside activities of the farmer are not covered. If the farmer is also engaged in other businesses, separate records should be made for these businesses. If in addition to his farm business he owns shares of stock in a corporation and holds a mortgage on some property, the income in dividends and interest on the mortgage should not be entered in the farm accounts. Better keep such cash receipts in a separate account. If such cash is deposited with the farm cash, debit cash and credit the withdrawal account. If you obtain the net farm income and add other outside income, you will obtain total net income. The same procedure will be followed to obtain his total net worth of farm and outside property.

Find the net worth of the farm business and add any other property less any outside debts.

There remains one more question. How will the farmer determine how much he has saved for the year from all sources?

- | | | |
|-------------------------------------------------------------------------|-------|--|
| 1. Determine farm net income..... | ----- | |
| 2. Add outside income..... | ----- | |
| 3. Total income..... | ----- | |
| 4. Subtract all living expenses as shown in the withdrawal account..... | ----- | |
| 5. Expenses paid from cash received from outside sources..... | ----- | |
| 6. Unpaid house bills..... | ----- | |
| 7. Depreciation on house and contents..... | ----- | |

(Household expense records should be kept if outside cash is used. The purchase of a piano is not an expense.)

Amount saved.....

6. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standarization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating students' work in bookkeeping are available, it is recommended that the final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*; while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in business practice should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value, both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following points in arriving at the rating:

1. Require neatness.
2. Insist upon complete explanatory matter in connection with all records.
3. Use problems 3 and 4 as tests after the course is completed. Allow all the time necessary for each of these tests up to two and a half hours each. A correct result should be obtained in one of the problems with at least an approximately correct result in the other.
4. Ability to distinguish between checks, notes, and drafts, and ability to explain the use of each.

PART 2. STUDENTS' INSTRUCTION SHEETS

NOTE.—These students' instruction sheets are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

LESSON 1

The plan of the records and the rules applicable thereto are explained in seven parts or divisions. Make a careful study of each of these. Be sure that you understand all terms used.

Plan of records and the rules to be applied

1. Secure an inventory at the beginning of the year of the farm, land, barns, produce of all kinds on hand, machinery and equipment, cattle, horses, hogs and any other stock. Do not include the value of the farmhouse or house furnishings or equipment. We will apply the term "inventory" to all items of farm property with which we are not going to keep special accounts. To the total inventory add any cash on hand or in the bank, notes and debts due from others. From this total deduct any debts and notes due others and the difference will show the net capital of the farmer in his relation to the farm business at the beginning of the year.

2. Special accounts will be kept as follows:

Cash account.—Enter the amount on hand at the beginning of the year on the debit or left side. The terms debit and credit are applied to accounts. A debit to an account means a record on the left side and a credit means a record on the right side. Enter all currency or checks received during the year on the debit side of the cash account and enter all currency or checks paid out or used for family, household equipment, house expense, or household improvements on the credit side of the cash account. The balance of this account at any time will show the cash on hand and in the bank. The balance in his account at the end of the year would be entered in a new cash account for the next year.

3. *Farm income and expense account.*—This account will be debited with all items of farm expense as such expense items are purchased or paid. If farm expense is paid in cash, the farm account will be debited and the cash account will be credited. The account will also be debited with all farm property bought. As sales are made or produce disposed of, the farm account will be credited. If cash is received for the sale, the cash account will be debited. If the sale is made to John Smith on account to be paid for later, an account with Smith will be debited. If produce is used in the house, this will be regarded as a sale and the farm account credited. The balance of the farm account at the end of the year will show a part of the farm profit or loss. We will assume the farm account shows an excess of credits over debits of \$2,000 at the close of the year. We will also assume that the items to which the term "inventory" applies at the close of the year is \$100 greater than it was at the beginning of the year. The farm account profit of \$2,000 plus the gain or increase of \$100 in inventory will show the net profit from the farm \$2,100. If the credits exceed the debits \$2,000 in the farm account and the inventory at the beginning of the year exceeds the inventory at the close of the year by \$100, the net farm profit would be \$1,900. The balance in this account at the end of the year should not be carried forward in the new farm account for the following year.

4. An account will be kept with the proprietor to show the amount of cash and produce withdrawn or used for living expense. This account, called "proprietor's withdrawals," will be debited for all cash or produce withdrawn for home use. There will be no credit records in this account. The use to be made of the records in this account will be referred to later. The balance in this account should not be carried forward.

5. Accounts with debtors and creditors will be handled in the same way as you did in unit 3. To illustrate: A purchase of feed of J. Jones to be paid for in 60 days; debit the farm account and credit J. Jones. When Jones is paid in cash, debit Jones and credit cash. A sale is made to B. Brown to be paid for in 90 days. Debit Brown and credit the farm account. When Brown pays his account, debit cash and credit Brown. These accounts should be continued until settled.

6. At the close of the year make a list of all farm property on that date as follows:

Inventory	x
Cash	x
Due from accounts and notes	x
<hr/>	
Total farm property or assets	x
Deduct all farm debts, accounts and notes	x
<hr/>	
Balance shows the farmer's net capital Dec. 31	x

7. From the net capital at the beginning of the year deduct the amount withdrawn as shown in the "proprietor's withdrawal account." Subtract this balance from the proprietor's net capital at the close of the year and the remainder will show the net profit which was obtained by adding the farm account profit to the excess of final inventory over the inventory at the beginning of the year.

LESSON 2

Study this problem and the solution and then, with the instructions in Lesson I as a guide, and without referring to the solution, work the problem. (Use journal sheets for statements and ledger sheets for accounts in this problem and in the problems that follow.)

Problem and solution.—The financial condition of Farmer Brown January 1, 1916, his activities during 1916, and his financial condition at the close of the year were as follows:

NOTE.—The details of each inventory item are omitted to make the problem more simple.

Inventory—January 1, 1916

Assets:

Land	\$9, 000
Barns	4, 000
Machinery equipment	1, 700
Produce	2, 000
Cattle and horses	2, 100

Other assets:

Cash	500
Due from J. Jones on account	1, 200

Liabilities: Due D. M. Moore on account	1, 000
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The activities during the year were as follows:

Farm produce sold for cash	\$4, 000
Produce sold to J. Jones on account	1, 000
Cash received from J. Jones on account	1, 200
Farm expense paid in cash	3, 500
Paid D. M. Moore cash on account	1, 000
Used cash for living expense	900
Used farm produce in home	400
Bought food of D. M. Moore on account	500

Inventory—December 31, 1916

Land	\$9, 000
Barns	3, 800
Machinery and equipment	1, 400
Produce	2, 500
Cattle and horses	2, 300

Prepare accounts for Farmer Brown and submit statements which will show his net profit by two methods.

Solution—Statement showing Mr. Brown's net capital January 1, 1916.—Inventories

Assets:

Land	\$9, 000
Barns	4, 000
Machinery and equipment	1, 700
Produce	2, 000
Cattle and horses	2, 100

Total inventory	\$18, 800
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Other assets:

Cash	500
Due from J. Jones	1, 200
	<hr/> 1, 700

Liabilities due D. M. Moore	20, 500
	<hr/> 1, 000

Net Capital Jan. 1, 1916	<hr/> 19, 500
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Accounts

CASH

Balance-----	\$500	Farm expense	\$3, 500
Produce-----	4, 000	D. M. Moore--	1, 000
J. Jones-----	1, 200	Living ex-	
		penses-----	900
Total Dr--	5, 700		
Total Cr--	5, 400	Total Cr--	5, 400
Balance---	300		

FARM ACCOUNT

Cash-----	\$3, 500	Cash-----	\$4, 000
D.M.Moore--	500	J. Jones-----	1, 000
		Home-----	400
Total Dr--	4, 000		
		Total Cr--	5, 400
		Total Dr--	4, 000
		Profit-----	1, 400

BROWN'S WITHDRAWALS

Cash-----	\$900
Produce---	400
Total----	1, 300

J. JONES

Balance----	\$1, 200	Cash-----	\$1, 200
Produce----	1, 000		
Total Dr--	2, 200		
Total Cr--	1, 200		
He owes--	1, 000		

D. M. MOORE

Cash-----	\$1, 000	Balance-----	\$1, 000
		Feed-----	500
		Total Cr--	1, 500
		Total Dr--	1, 000
		I owe-----	500

Statement showing Mr. Brown's net capital, December 31, 1916

Assets:

Inventory—

Land-----	\$9, 000
Barns-----	3, 800
Machinery and equipment-----	1, 400
Produce-----	2, 500
Cattle and horses-----	2, 300

Total inventory----- \$19, 000

Other assets:

Cash-----	300
Due from J. Jones-----	1, 000
	1, 300

Total assets----- 20, 300

Liabilities: Due D. M. Moore----- 500

Net capital Dec. 31, 1916----- 19, 800

Net capital Jan. 1----- 19, 500

Less withdrawals (See Brown's account)----- 1, 300

18, 200

Net farm profit----- 1, 600

Proof:

Inventory, Dec. 31.....	\$19,000
Inventory, Jan. 1.....	18,800
Increase in inventory.....	200
Profit from farm account.....	1,400
Net farm profit.....	1,600

LESSON 3

Using the model in lesson 2 as a guide, solve the following problem:

Problem 2

On January 1, 1918, Amos Munson owned property, and had debts as listed below:

Farm land.....	\$20,000
Farm buildings.....	5,000
Machinery and equipment.....	1,200
Produce.....	1,000
Cattle and horses.....	2,700
Cash.....	600
Due from S. Flynn.....	800
Due to W. P. Cox.....	1,300

His farm activities for the year were as follows:

Sales for cash.....	6,500
Farm expense paid in cash.....	3,800
Cash used for living expense.....	1,200
Produce used in home.....	500
Produce sold to D. Flynn on account.....	1,000
Feed and lumber bought from W. P. Cox on account.....	700
Cash received from D. Flynn on account.....	800
Cash paid to W. P. Cox on account.....	1,300

December 31, 1918

Inventories:

Farm land.....	20,000
Farm buildings.....	4,800
Machinery and equipment.....	1,080
Produce.....	1,700
Cattle and horses.....	2,600

1. Submit a statement to show Munson's condition January 1.
2. Show the activities of the year in accounts.

LESSON 4

Using problem 2 in lesson 3 above, work out the following:

1. Submit a statement to show Munson's condition December 31.
2. Determine the net profit by the two methods.

LESSON 5

Problem 3

The Norton Farm, January 1, 1917

Assets:

Cash.....	\$900
Due from D. B. Lord.....	800
Produce.....	850
Horses and cattle.....	3,000
Machinery and equipment.....	2,800
Land.....	18,000
Buildings.....	5,400

Liabilities:

Due A. W. Smith.....	750
Due W. A. Fox.....	1,100

Business transactions for the year were as follows:

Sales for cash.....	\$5, 600
Sales to D. B. Lord on account.....	1, 160
Produce used in the home.....	430
Cash payments for farm expense.....	3, 680
Cash payments to A. W. Smith and W. A. Fox for the full amounts due them..	
Cash used for living expense.....	1, 100
Purchase of feed and materials of A. D. Jones on accounts.....	950

Assets not shown in accounts December 31

Produce.....	1, 300
Horses and cattle.....	3, 100
Machinery and equipment.....	2, 600
Land.....	18, 000
Buildings.....	5, 184

1. Prepare a statement to show Mr. Norton's net capital January 1, 1917.
2. Show the activities of the year in accounts.

LESSON 6

Using problem 3 in lesson 5 above, work out the following:

1. Prepare a statement to show Mr. Norton's net capital December 31.
2. Determine the net profit by the two methods.

LESSON 7.—BUSINESS PAPERS

Invoice and bill

When goods are sold, the seller prepares an invoice for the purchaser.

The invoice contains the date, name, and place of seller and name and place of purchaser, terms of payment, items, prices, extensions, and total.

The terms "invoice" and "bill" are to some extent used interchangeably, but the term "bill" is more appropriately used in a transaction in which services have been performed or services performed and materials furnished in connection with the service.

We speak of an invoice of merchandise, a gas bill, a telephone bill, a bill for services and material.

Invoice

Mr. W. A. FORD,
Troy, N. Y. NEW YORK, N. Y., January 14, 191...

Bought of Brown & Co., dealers in flour and feed,
24 Washington Street

Terms: On account 10 days.

25 barrels X flour	\$6	150	
30 barrels XX flour	\$6.50	195	345

Bill

Mr. S. M. DE VOE,
1284 Eighth Avenue, New York, N. Y. NEW YORK, N. Y., January 15, 191...

To A. D. Lane, debtor, carpenter and repairer, 1267 Eighth Avenue

Terms: Cash.

To 500 feet 1-inch pine	\$50	25	
To 5 days' labor *	\$4	20	45

A receipt is written evidence of payment

\$230.00	New York, N. Y., February 14, 1916.
Received of A. M. SIME Two Hundred Thirty -- 00/100 Dollars.	
In full of account to date.	
	WM. SMITH.

When payments are made some form of receipt should be obtained; otherwise you may have to pay a second time.

In some transactions it is customary to give a formal receipt as illustrated above. In case of lighting for the home, the original bill is frequently returned to the gas or electric company with a check for the amount and the company marks the bill "paid" and adds signature and then returns the bill to the customer.

This is sometimes done when an invoice of goods is paid for.

Receipted Invoice

BUFFALO, N. Y., February 16, 1915.

Mr. W. D. SPRINGER,
Rochester, N. Y.

Bought of Jones & Smith,
26 Main Street

Terms: Cash.

	2	Cases 72 pairs No. 64 shoes	\$2. 50	\$180	
	1	Case 36 pairs No. 50 shoes	\$2. 25	81	
					\$261

Paid February 19, 1915.

SMITH & JONES, Per J.

The bank and its function

The service rendered by banks is absolutely indispensable to the business man of the present day.

There are a variety of banking institutions, savings banks, trust companies, and commercial banks. The business man is especially concerned with the services rendered by the commercial bank or the trust company doing a commercial banking business. This service consists of loaning money, extending credit, facilitating the collection of obligations, affords a secure place for the safe-keeping of money, permits depositors to issue checks against deposits and in many instances commercial banks are paying interest on monthly balances.

How to open a bank account—Identification.—If you are not personally known by an officer of the bank, it will be necessary for you to be identified by some one who is known by a member of the bank and one who can speak of your business ability and integrity.

Signature.—You will be required to sign a card or book in the form you intend to sign business papers, so that the officers of the bank will have a means of verifying your signature on business papers they may receive.

The following forms and books are usually furnished by banks without charge:

Deposit slips on which to list items deposited.

Pass book in which deposits are entered by an officer of the bank.

Check book containing blank checks.

LESSON 8.—BUSINESS PAPERS—CONTINUED

Negotiable papers

Check.—A check is an unconditional written order by a depositor upon his bank directing the bank to pay a certain sum, in money, to a certain party or order, or to bearer upon the presentation of the check properly indorsed.

The parties to a check are the drawer, the one who writes or executes the paper, the payee, the one to whom the order is made payable, and the drawee, the bank upon which the order is drawn.

Form of check

No. 100	New York, N. Y., January 2, 191--
CHEMICAL NATIONAL BANK	
Pay to the order of JOHN SMITH.....	\$2,500
Twenty-five Hundred.....	00/100 Dollars.
S. D. NORTON.	

Promissory note

A promissory note is an unconditional written promise made by a party called the maker, to pay a certain sum of money, to a party called the payee, or order, or to bearer at a certain or determinable time.

The parties to a note are the maker, the one who makes the promise to pay, and the payee, the one in favor of whom the promise is made, and who is to receive payment at the designated time.

Form of note

\$2,150	New York, N. Y., April 12, 191--
Two months after date I promise to pay to the order of	
JOHN FORSTER.....	
Twenty-one Hundred and Fifty.....	00/100 Dollars.
Value received. Payable at First National Bank without interest.	
No. 21. Due June 12, 191--.	D. B. STORM.

Draft

A draft is an unconditional written order made by a party called the drawer addressed to a party called the drawee, directing him to pay a certain sum of money to a party called the payee, or order, or to bearer, at a certain or determinable time.

The parties to a draft are the drawer, the one who issues the order; the drawee, the one who is ordered to pay, and the payee, the one to whom payment is to be made.

Sight draft

\$400	New York, N. Y., February 10, 191--
At sight pay to the order of Myself.....	
Four Hundred.....	00/100 Dollars.
Value received and charge to account of	
To JOHN GEORGE, Albany, N. Y.	
No. 60	WM. SMITH.

Time draft

\$600	New York, N. Y., March 12, 191--
Sixty days after date pay to the order of Myself-----	
Six Hundred-----	00/100 Dollars.
Value received and charge to account of	
To FRED WILLIAMS, Troy, N. Y.	
No. 50. Due May 11, 191--	JOHN JONES.

Time-sight draft

\$2,100	New York, N. Y., March 15, 191--
At thirty days' sight pay to the order of Myself-----	
Twenty-one Hundred-----	00/100 Dollars.
Value received and charge to account of	
To GEO. DONALSON, Syracuse, N. Y.	
No. 6. Due-----	A. L. MOORE.

Chicago Bank draft

\$1,000	New York, N. Y., March 20, 191--
NEW YORK NATIONAL BANK	
Pay to the order of JOHN MASON-----	
One Thousand-----	00/100 Dollars.
To CHICAGO NATIONAL BANK, Chicago, Ill.	
WM. NORMAN, <i>Cashier.</i>	

Negotiable paper is paper that can be transferred by indorsement and delivery or by delivery alone. Three forms have been illustrated—check, note and draft.

If negotiable paper is made payable to bearer, as is the case with paper money, we may pass it without indorsement, but when payable to a designated party or order, as is customary in checks, notes and drafts, it is necessary to indorse the paper to pass good ownership to the one who receives it.

Indorsement

An indorsement is the writing of the name of the indorser on the back of negotiable paper for the purpose of passing good title or adding strength to the security of the one receiving the paper or both.

The two forms of indorsements in general use are the blank and full.

Blank indorsement for check on page 20, containing check shown at beginning of this lesson:

JOHN SMITH

Full indorsement for the same check if the payee desires to deposit it in the National Exchange Bank.

<p>Pay to the order of National Exchange Bank.</p> <p>JOHN SMITH.</p>

Business papers

The bank indorsement by the payee makes the paper payable to bearer, while the full indorsement makes the paper payable to a designated party or order. The full form is the more desirable when there are possibilities of the indorsed paper being lost or not reaching the party to whom it is the intention to transfer. The legal consequences of these two indorsements are that the indorser agrees to pay if the one directly obligated fails to pay and prompt notice of this fact is given.

Other forms of indorsement are conditional and restrictive.

Conditional indorsements for note on page 21, showing promissory note above. If the payee desired to transfer the note to A. D. Moore and Moore was willing to accept this form of indorsement:

<p>Pay to the order of A. D. Moore without recourse to me.</p> <p>JOHN FORSTER.</p>	OR	<p>Without recourse.</p> <p>JOHN FORSTER.</p>
---------------------------------------------------------------------------------------------	----	-----------------------------------------------

This form of indorsement transfers title, but does not obligate the indorser if the paper is dishonored at maturity, unless the maker is an infant or the paper forged or given for an illegal purpose.

Restrictive indorsement for note on page 21, showing promissory note above:

<p>Pay to A. D. Moore only.</p> <p>JOHN FORSTER.</p>

This indorsement restricts further negotiability.

Occasionally a partial payment is made on a note. Such payments are indorsed on the note as follows:

Received on the within note	
Jan. 2, 1914.....	\$500
Dec. 3, 1914.....	200

LESSON 9—BUSINESS PAPERS—CONTINUED

The function of negotiable paper and the accounting records its use involves

The aim in business concerns is to convert their stock in trade into a convenient form of purchasing power—that is, cash or its equivalent.

Negotiable paper is the connecting link in this process in many business transactions.

Checks

It is a great convenience to issue checks in payment of obligations and not be required to risk sending currency or even to carry on hand large amounts of currency for the purpose of making payments.

Checks are intended for use in one transaction only and in the general vicinity of the bank on which they are drawn. The limitation of their use should be the State in which the drawee bank is located or near-by centers in adjoining States.

Checks are treated as cash in accounting records and are therefore governed by the rule for cash. Cash is debited when checks are received in payment and cash is credited when checks are issued in payment.

Checks may be transferred several times, but it is not customary to do so.

Promissory notes

In the sale of goods on account 30 days, the seller acquires a claim against the buyer. This claim, known in accounting as an open account, is an asset, but this asset can not be conveniently converted into cash until the expiration of the term of credit, 30 days. A sale in which a 30-day note is received in payment is generally more desirable than the former terms. The note is an asset which commercial banks will buy if the financial standing of the parties is satisfactory. Notes can be readily converted into cash, while open accounts can not.

Notes receivable

Other people's notes when received by you are recorded on your books as debits under the title of notes receivable. When such notes are paid at maturity or transferred by you before maturity, you record them as credits under the title of notes receivable.

The balance in notes receivable account is an asset and represents the amount of notes you hold against other people.

Notes payable

Your written promises to pay other people are recorded under the notes payable. When you issue your notes, you credit notes payable, and when you redeem your notes, you debit notes payable.

The balance of notes payable account is a liability and represents the amount of your notes outstanding.

Drafts

A draft is a command to pay money to a designated party, the basis of which is that the one on whom the draft is drawn owes the drawer.

In the terms of a sale of goods it is frequently agreed that the seller may draw upon the buyer at sight or within a specified number of days. This may give rise to a sight draft, sight-time draft, or pure time draft, depending upon the terms of the sale.

New York, N. Y., March 1, 191--

Sell J. E. Jones, Troy, N. Y., terms: S/D (sight draft) merchandise \$850. The agreement in the terms of this sale is that the seller may draw on J. B. Jones at sight for the amount at once. A draft would be drawn for the amount and indorsed over to the bank of the seller and left at the bank with instructions to collect.

Form of draft referred to above

\$850	New York, N. Y., March 1, 191--
At sight pay to the order of Myself.....	
Eight Hundred Fifty.....00/100 Dollars.	
Value received, and charge to account of	
To J. B. JONES, Troy, N. Y.	
No. 7.	S. STUDENT.

Payee's indorsement to transfer the draft to his bank for collection;

Pay to the order of First Na- tional Bank. S. STUDENT.

Sight drafts are sometimes drawn against past due open accounts, as a means of pressing payment.

Time drafts are used when the terms of sale or purchase so provide, or by special agreement between the debtor and creditor.

Time drafts are presented to the drawee for his written agreement to the terms of the draft.

When a draft is accepted it becomes a direct agreement of the drawee to pay the payee or order, and when received by the payee is recorded as a debit under the title of notes receivable.

The drawee of a time draft which he has accepted bears the same relation to the draft as the maker of a note does to a note.

Time-sight drafts differ in no respect from pure time drafts, except the time stated in the paper does not begin to run until the date acceptance.

Three-party draft

Assume that you owe J. Smith, of Buffalo, \$400, and B. Brown, of Buffalo, owes you \$400 or more. You might ask Brown to pay your debt to Smith, thereby cancelling your debt to Smith and collecting all or a part of Brown's debt to you. This could be accomplished by drawing at sight on Brown in favor of Smith and remitting the draft to Smith.

Form of the draft

\$400	New York, N. Y., May 10, 191..
At sight pay to the order of J. SMITH.....	
Four Hundred.....	Dollars.
Value received, and charge to account of	
To B. BROWN, Buffalo, N. Y.	
No. 10.	S. STUDENT.

Bill of Lading

A bill of lading is a document issued to the shipper, by a transportation company, setting forth the conditions under which the transportation of the goods is undertaken. It is the contract between the parties. Copies are signed by both the shipper and the transportation company.

The original copy which the shipper receives is forwarded by him to the buyer, the one to whom the goods are shipped.

When the goods arrive, the buyer can obtain them by presenting the bill of lading. One form of the bill of lading, known as the order bill of lading, is used extensively in large sales made on a cash basis.

When a Watertown, N. Y., farmer purchases a carload of feed from a Buffalo dealer, the dealer usually uses the order bill of lading. The feed is shipped, and the dealer draws a sight draft on the farmer and indorses the draft and bill of lading over to his Buffalo bank. The Buffalo bank indorses the documents, and forwards them to a bank in Watertown. Upon receipt of the documents, the Watertown bank notifies the farmer, that upon payment of the draft, they will surrender the bill of lading. When the goods arrive, the farmer pays the draft and obtains the bill of lading. He then presents the bill of lading at the local freight office, and is permitted to remove his carload of feed.

LESSON 10

Problem 4

The A. N. Jones Farm. January 1, 1917

Inventory; assets:

Land.....	\$20, 000
Buildings.....	6, 000
Machinery and equipment.....	2, 000
Horses, cattle, hogs, etc.....	3, 000
Produce.....	1, 800
	<hr/> 32, 800

Other assests:

Cash.....	650
Due from A. N. Lane.....	170

Liabilities:

Due A. D. Smith.....	350
----------------------	-----

A few of the transactions for the year will be given in detail, the other transactions will be given in totals. Open necessary accounts and make the records.

Farm produce sold for cash, \$7,650.

Farm expense paid in cash, \$4,100.

Cash received for work done by men and teams (credit the farm), \$10.

Cash received from A. N. Lane to balance account, \$170.

Paid A. D. Smith amount due, \$350.

Men and teams worked four days for L. N. Snow, payment to be made later by help from Mr. Snow. Value of service (credit the farm and charge Snow), \$20.

Traded horses with Jack Dowling. You received a horse valued at \$100 and his 90-day note with interest at 6 per cent for \$100 in exchange for one of your horses. Charge the farm for \$100 and credit the farm for \$200. Charge notes receivable for \$100.

Withdrew cash for private use, \$800.

Farm produce used in home, \$150.

Bought feed of A. N. Lane on account, \$200.

Bought farm machinery of D. O. Flynn and gave a 90-day interest-bearing note in payment (debit the farm and credit notes payable), \$140.

Sold farm produce to D. J. Fox on account, \$80.

Sold farm produce to A. C. Donovan and received his 60-day interest-bearing note in payment (debit notes receivable and credit farm), \$120.

Jack Dowling paid his note and interest in cash; note \$100, interest \$1.50. (Debit cash \$101.50, credit notes receivable \$100, and credit farm \$1.50.)

Paid D. O. Flynn cash for note and interest, note \$140, interest \$2.10. (Debit notes payable \$140; debit farm, \$2.10, and credit cash for the total).

L. N. Snow gave us help with his men and teams to settle his account (debit the farm and credit Snow), \$20.

A. C. Donovan paid his note and interest in cash. Note \$120, interest \$1.20. (This is the same as the record when Dowling paid his note.)

Sold farm produce to H. E. Sweet and received his 30-day noninterest-bearing note in payment (refer to the sale to Donovan), \$200.

Bought two cows of D. W. Norman and gave a three-months' note in payment (charge the farm and credit notes payable), \$185.

Inventory, Dec. 31, 1917:

Land.....	\$20, 000
Buildings.....	5, 760
Machinery and equipment.....	1, 900
Horses, cattle, etc.....	2, 100
Produce.....	1, 500

LESSON 11

Determine Jones's net profit for the year.

The notes receivable account shows an asset of \$200 and the notes payable account a liability of \$185. Fox is a debtor and Lane is a creditor.

LESSON 12

October 1, 1917: F. T. Mott purchased a farm, including produce, cattle, horses, hogs, poultry, machinery, and equipment at values stated below:

Land, 200 acres (\$50)-----	\$10, 000
Buildings-----	4, 200
Cattle:	
30 cows-----	2, 250
10 young stock-----	250
Horses, 4-----	700
Hogs, 6-----	100
Poultry, 40-----	32
Machinery and tools (a detailed list of all articles should be given).-----	800
Produce:	
Oats, 600 bushels-----	300
Wheat, 75 bushels-----	150
Hay, 100 tons-----	1, 500
Silage, 90 tons-----	350
Other produce and feed-----	50
Mr. Mott had cash in the bank available for farm business-----	350

The value of the house and the furnishings and other property and debts that were not a part of the farm enterprise are not listed. Use a double sheet of journal paper for the cash account. The left page for cash receipts and the right page for payments. Enter the amount in bank on the debit side under date of October 1, 1917. Use a second double sheet of journal paper for the farm account. The left page for farm expense or the purchase of farm property and the right page for income or sales of farm property. Use ledger paper for other necessary accounts. Allow a half page for each. Use a separate sheet for "Mott's withdrawal account."

The text material from which you are to make your records is all conveniently arranged, clearly stated and properly dated, but in actual practice the farmer does not have a textbook from which to copy his records. He should carry a pocket notebook in which to make full notes of the transactions for the day. At the end of the day, or two or three times each week, these notes should be transferred in ink to a bound book about the size of a journal sheet and arranged under proper dates with all details stated.

This record would correspond to the transactions as stated in the text. The accounts should then be written up. As the transactions are transferred to the accounts they should be checked.

The statement of assets and liabilities or other statements at the beginning or close of the year should be retained. A bound book might be used for these statements and for a detailed inventory. There are many important facts not related to the bookkeeping records that should be noted throughout the year. A special book might be used for such items.

Mr. Mott's transactions for the balance of the year follow:

LESSON 13

Enter these transactions in accounts:

Oct. 2. Paid cash for groceries (charge withdrawal and credit cash)-----	\$25. 00
Oct. 10. Sold Lane 2 calves for cash-----	5. 00
Oct. 19. Paid cash for farm help-----	45. 00
Oct. 20. Used cash for personal and family use-----	40. 00
Oct. 22. Bought an automobile of W. A. Mason-----	1, 000. 00

To be paid for as follows: Cash \$200, and 2 notes with interest at 6 per cent to run 2 and 4 months, respectively, \$400 each. (Charge the farm for the cost of the automobile, credit cash for \$200 and open an account with notes payable and credit the accounts with two amounts. No record will be made for the interest until it is paid.)

Oct. 24.	Bought 50 gallon gasoline for cash.....	\$12. 50
Oct. 30.	Sold 4 dozen eggs for cash.....	1. 60
Oct. 30.	Paid cash for farm help.....	40. 00
Nov. 5.	Received check for October milk.....	220. 00
Nov. 10.	Bought feed of Nolan Bros. On account 60 days. (Open an account with Nolan Bros., and charge the farm.).....	100. 00
Nov. 12.	Sold for cash 10 tons of hay.....	250. 00
Nov. 15.	Paid cash for farm help.....	45. 00
Nov. 20.	Sold a horse to Will Spencer and received in payment a cow valued at \$70, and his 30-day note with interest for \$140. (Credit the farm for the sale of the horse for \$210 and charge the farm for a cow at \$70. Open an account with notes receivable and debit the account for \$140.).....	
Nov. 25.	Sold one hog for cash.....	29. 50
Nov. 30.	Paid cash for farm help.....	38. 00
Dec. 5.	Sold one cow to W. A. Morris and received his 20-day noninterest-bearing note in payment.....	90. 00
Dec. 6.	Received November milk check.....	245. 00
Dec. 15.	Paid cash for farm help.....	45. 00
Dec. 20.	Received cash from Will Spencer for note and interest due to-day—note, \$140; 30 days' interest, \$0. 70. (Debit cash for \$140. 70. Credit notes receivable for \$140 and credit the farm for \$0. 70.).....	
Dec. 22.	Paid W. A. Mason cash for note and interest due to-day. Face of note \$400, interest for 2 months \$4. (Debit notes payable \$400, debit the farm for the interest \$4 and credit cash for \$404.).....	
Dec. 25.	Received cash from W. A. Morris for his note.....	90. 00
Dec. 30.	Paid cash for farm help.....	50. 00
Dec. 31.	Received check for December milk.....	190. 00
Dec. 31.	Milk and other farm produce consumed in home for 3 months.....	20. 00

LESSON 14

The following is an inventory of Mr. Mott's farm property not shown in his accounts, December 31, 1917:

Inventory, December 31, 1917

Land.....	\$10, 000
Buildings.....	4, 150
Cattle.....	2, 600
Horses.....	550
Hogs.....	110
Poultry.....	30
Machinery and equipment.....	775
Produce.....	1, 800
Automobile.....	950

Other assets and debts

The cash balance is \$577.30. There is one unpaid note out and there is a debt due Nolan. Determine the amount of profit or loss for the three months.

LESSON 15

A part of Mr. Mott's farm activities for the year 1918 will be given in the total, and the balance in detail. Make the records. Enter the cash balance December 31, 1917, on a new double journal sheet and use a new double sheet for the farm account. Do not carry the balance of the previous year forward in this account. Open a new "withdrawal account." Do not carry the balance of the previous year forward in this account. Continue the use of the other accounts. Whenever the two sides of an account are equal, single rule, add and double rule the account, and continue any new records below the double ruling.

Transactions for 1918

Jan. 10.	Sold farm produce to William Nelson on account	\$240. 00
Jan. 14.	Paid Nolan Bros. cash to balance account	100. 00
Feb. 15.	Sold farm produce to D. L. White and received his 60-day note with interest in payment	154. 00
Feb. 23.	Paid W. A. Mason cash for note and interest due to-day. Note \$400, interest, 4 months, 1 day, \$8.07	408. 07
Mar. 15.	Received cash of William Nelson in full of account	240. 00
Apr. 16.	Received cash of D. L. White for note \$154 and 60-days interest due to-day.	
May 14.	Traded with Amos Clark the automobile valued at \$900 for a team of horses valued at \$425 and received note at 6 months with interest for the balance. (Charge the farm for the horses; charge notes receivable and credit the farm for the automobile.)	
June 14.	Bought farm machinery from J. D. Manning and gave a 4-months' note with interest in payment	210. 00
June 30.	Other cash sales of farm produce and property Jan. 1 to date	2, 900. 00
June 30.	Farm expenses paid in cash Jan. 1 to date	1, 800. 00
June 30.	Farm produce used in home to date	79. 00
June 30.	Cash for living expenses to date	560. 00
Oct. 14.	Paid J. D. Manning cash for note and interest due to-day; note, \$210; interest, 4 months.	
Nov. 14.	Received cash of Amos Clark for note and interest due to-day; note, \$475; interest, 6 months.	
Nov. 15.	Killed and dressed a hog weighing 225 pounds. Received cash for 100 pounds at 15 cents at market. A farm employee took 50 pounds at 12 cents to apply on wages. The balance was retained for family use at 12 cents. (Credit farm for total, \$29. Charge cash for amount paid at market. Charge farm for amount taken by employee and charge drawing account for balance. When settlement is made with employee, it will be necessary to refer to the farm record. It is very important that all details be stated in the records.)	
Dec. 15.	Sold 2 cows to O. D. Boyce on account, 30 days	160. 00
Dec. 17.	Bought a two-unit milking machine of Connor Bros. and gave a note at 60 days in payment. (Charge the farm and credit notes payable.)	425. 00
Dec. 20.	Sold 10 tons hay to James Swift and received his 30-day note in payment	200. 00
Dec. 25.	Bought feed at Miller Bros. on account	95. 00
Dec. 31.	Other sales of produce and farm property, July 1 to date for cash	2, 845. 00
Dec. 31.	Cash payments for farm expense and farm property, July 1 to date	15. 60
Dec. 31.	Farm produce used in home, July 1 to date	68. 00
Dec. 31.	Cash used for living expense, July 1 to date	562. 00

LESSON 16

Prepare a statement to show Mr. Mott's worth Dec. 31, 1918, and determine his net profit or loss for the year.

Inventory, Dec. 31, 1918

Land	\$10, 000
Buildings	4, 000
Cattle	2, 450
Horses	600
Hogs	75
Poultry	25
Machinery and equipment	1, 225
Produce	1, 980

Other assets.—Cash, one note and an account against Boyce.

Liabilities.—One note outstanding and an account favor Miller Bros.

LESSON 17

Problem 3 text as a test.

LESSON 18

Problem 4 text as a test.

Rehabilitation monograph. Joint Series No. 64.

Unit Course—Printing 1—Elementary Composition for Printers

PRINTING

February, 1919—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENTS

This course is intended for beginners in printing. No previous experience in printing is required, but a common-school education is necessary. If the student is to prepare for the higher positions in the industry, the foundation ought to include a high school or even a college education.

2. THE AIM OF THE COURSE

This course is a preparatory course for beginners in printing. It is expected that the student finishing this course in a satisfactory manner should know:

1. The location of all the characters in the type case (upper and lower news cases and California job case).
2. How to set, properly space, and justify straight-matter composition.
3. How to remove composed type from the stick, take proof, and make corrections.
4. How to distribute type.

3. LENGTH OF COURSE

This course is intended to cover 30 hours of instruction. In order to bring the course within this time, the instructor will make necessary modifications in the exercises for practice by the student.

4. EQUIPMENT AND MATERIALS FOR FIVE-MAN UNIT—STRAIGHT COMPOSITION

- 100 pounds 2-point leads in strips.
- 10 pounds 1-point leads in strips.
- 25 pounds 6-point labor-saving slugs.
- 1 Poco proof press, with stand.
- 1 Hensen lead and rule cutter.
- 5 steel star composing sticks (nickeled), 8 by 2.
- 1 steel star composing stick (nickeled), 15 by 2.
- 2 fonts 6-point Century expanded.
- 2 fonts 8-point Century expanded.
- 160 pounds 10-point Century expanded.
- 40 pounds 12-point Century expanded.
- 1 font 6-point spaces and quads, 5-pound.
- 1 font 8-point spaces and quads, 5-pound.
- 20 pounds 10-point spaces and quads—regular spaces, *not* point set. All 4-to-em spaces to be nicked with one nick, others without nick.
- 1 font 12-point spaces and quads, 5-pound.
- 1 font 6-point Century expanded italic.
- 1 font 8-point Century expanded italic.
- 2 fonts 10-point Century expanded italic.
- 1 font 12-point Century expanded italic.

- 1 compact quarter-size rule case.
- 10 pounds labor-saving hair-line brass rule No. 1002.
- 1 maple planer, $3\frac{1}{4}$ by 6.
- 1 proof planer, $3\frac{1}{4}$ by 8.
- 1 font 24-point Century expanded caps.
- 1 No. 2 3 by 5 medium hickory mallet.
- 1 quart-size McNutt nonexplosive benzine can.
- 1 2-gallon McNutt nonexplosive storage benzine can.
- 3 Wisconsin window cabinets No. 2, to include one pair of news and the remainder to be California job cases.
- 1 pound Sullmanco job black ink (in tubes).
- 1 dozen pair No. 1 Challenge Hemple quoins.
- 2 No. 1 Challenge Hemple quoin keys.
- 2 benzine brushes.
- 5 brass job galleys, 6 by 10.
- 2 gallons benzine.
- 6 balls of page cord.
- 1 Economic imposing stone and frame.
- 1 Boston lead rack No. 4.
- 5,000 sheets proof paper, $8\frac{1}{2}$ by 11.
- 6 steel composing rules, 20 picas wide.
- Job press not to be included in this unit.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

Upon the completion of this unit course the student will be given a certificate stating his rating for the course. Duplicates of all certificates granted should be kept on file by the school for future reference.

It is intended that all certificates given for completion of the unit courses issued by the committee on courses of study for disabled soldiers under the direction of the Surgeon General's Office and the Federal Board for Vocational Education shall be honored by all schools under the supervision of either of these agencies, so that the student transferring from a hospital school to another school may receive due credit for the work done in the former school, and may take additional units in the second school.

It is therefore desirable to establish some uniformity or standardization in the methods of rating and recording of the work of students.

A record should be kept of each lesson performed throughout the course. At the discretion of the instructor, a test may be given at the close of the course, but the final rating should represent the work of the student throughout the course as well as his standing in the final test or examination.

Until more definite scales for rating printing are available, it is recommended that final rating be recorded as follows: The average student will be rated *good*; the student of exceptional ability will be rated *excellent*, while the student of lesser ability will be rated *fair*. The student producing work of a quality that would be rejected in the commercial shop should be rated *poor*.

Out of justice to the student, his rating should be more than a mere guess or snap judgment on the part of the instructor. In order that the rating may be just and of value both as a credential for the student and as a record for the school, the instructor is requested to consider carefully the following factors in arriving at the rating:

(1) Execution of work:

(a) *Time*.—Is the student rapid, moderate, or slow in executing his work?

(b) *Technique*.—Does the student use workmanlike methods? Does he exercise reasonable economy in use of materials? Is he neat and orderly in care of tools and materials?

- (2) Finished product:
 - (a) *Accuracy*.—Should be determined by the record kept of errors in composition.
 - (b) *Quality*.—Consider the finished product in other respects than accuracy, such as justification, uniform spacing, neatness, etc,
 - (c) *Mastery of principles*.—Does the work indicate that the student has sufficiently mastered the principles involved in the lesson, or is there still some deficiency that should be made up?
- (3) Interest:
 - (a) *Attitude toward work*.—Does the student love his work or does he watch the clock? Is he likely to continue in this line of work?
 - (b) *Studiosness*.—Does the student show disposition to study the printed literature related to this work? Does he express a desire to take advanced unit courses in this or related subjects?
 - (c) *Possibilities of growth*.—Is the student likely in due time to receive promotion to positions of greater responsibility?
- (4) Test problem:

A test problem might be given at the conclusion of the course which would determine the ability of the student to perform the following:

 - (a) To fill in independently a blank diagram of the California job case and the upper and lower news cases.
 - (b) To set from manuscript copy 200 ems of 10-point (solid) straight matter; take proof and make corrections. The type to be uniformly spaced and properly justified and to have not more than four typographical errors. This work to be done in one hour.
 - (c) To properly distribute the same type in fifteen minutes.

6. OUTLINE OF LESSONS

- Lesson 1: Lay of the California job case.
 Lay of the upper and lower news cases.
 Operations of typesetting and distribution.
 Distinguishing the difference between the lower-case b and q, d and p, and n and u, 6 and 9.
- Lesson 2: Spacing material used in plain composition.
 Use of the spacing chart.
 Relative sizes of the spaces and quads.
 Spacing problems.
- Lesson 3: Plain paragraph composition.
 Paragraph indentation, division of words, spacing of sentences within paragraphs, quadding out.
 Operations of tying type, proof taking, marking, and correcting.
- Lesson 4: Paragraphs set in hanging indentation and half-diamond indentation.
 Composition of poetry.
 Ledged, double-ledged, and solidified composition.
- Lesson 5: Reprint copy set in different measures.
 Typewritten copy, manuscript copy.
- Lesson 6: Characters which comprise a complete font of text types.
- Lesson 7: The American point system.

7. GENERAL DIRECTIONS FOR CONDUCTING THE WORK

- (a) Do not start work on the exercises until the class has been informed about the equipment and material necessary to set type by hand.
- (b) Give as much individual instruction as possible.
- (c) Demonstrate the proper position to stand at the case.
- (d) Insist that type or other material dropped on the floor be picked up at once.
- (e) When the first proof of exercise No. 6 has been read and marked for correction by the instructor, the student should be taught the proof reader's marks and how to make the cor-

rections. Give special attention to the spacing when the proofs are being read. Train the pupils to recognize even distribution of white space and mark all spacing faults on the proofs.

(f) Do not allow the use of tweezers. Teach the use of the fingers in making corrections.

(g) When corrections are made, care should be taken to preserve the justification and prevent the uniformity of the spacing from being impaired. The lines should always be corrected in the stick.

(h) It is especially important that pupils be taught good justification and careful spacing in the first lines assembled.

(i) Thorough drilling in the principles of spacing should be given, in which the pupils are made to recognize the characters which require extra space and the characters after which the space may be diminished.

(j) Regular spaces, each size of which is a fractional part of an em, will be found more practicable for teaching the proper spacing of straight matter than point-set spaces. In ten point the "3-to-em" space is $3\frac{1}{2}$ points thick in point-set fonts. There is no material difference in the other 10-point spaces. *The spacing chart shown in Lesson II can not be used with point-set spaces.* Have the 4-to-em spaces nicked to insure clean distribution.

(k) The standard arrangement of the type case should be taught. Changes in the lay of the type case are not looked upon with favor by the average printer and innovations are slow to find general acceptance by the craft.

(l) A suitable folder or notebook should be provided each member of the class and all proofs of the exercises kept therein.

SUGGESTIONS FOR TEACHING LESSON NO. I

In *exercise No. 1* we start with the lower-case "e" in teaching the lay of the case. Call the attention of the class to the largest compartment in the case and explain that it contains the most used letter of the alphabet.

The operation of emptying the stick and the position and the control of the fingers in distribution are taught when the student handles this exercise.

In the *second exercise* other letters are added as each new line is assembled. The words are spaced with the 3-to-em space and all lines are so arranged that they justify automatically. *All sticks* should be set to a measure of 20 picas.

The specially prepared copy used for this exercise is composed in new Caslon, but the instructor will find that the exercise can be composed in any type face with but few alterations in the text.

Pupils "learn by doing" and the location of the compartments in the type case soon become firmly fixed in their minds. The teacher should explain why the various letters are arranged in their relative positions and the necessity of preserving this arrangement in every type case.

Each line of the first and second exercises should be removed from the stick and distributed immediately; thus the student will not have more than a single line in the stick at one time.

Before proceeding to exercise No. 5 the instructor should make sure that the student knows:

1. The location of the most used letter in the case and the 3-to-em spaces (without the aid of diagram).
2. The correct way to hold the composing stick.
3. How to pick up and assemble type in the stick.
4. How to remove a line of type from the stick.
5. How to hold the type in the hand for distribution.
6. The proper position and control of fingers in distribution.

The card shown on Plate II will be found helpful in teaching the pupil how to distinguish between letters that confuse. Each pupil should be supplied with one of these cards.

SUGGESTIONS FOR TEACHING LESSON NO. II

The matter of uniform spacing is of great importance and should be given careful attention. Exercise No. 5 will make the student familiar with the spacing material.

Justification is taught at this point. In the preceding exercises the 3-to-em space is the only space used.

The instructor should see that the student keeps the spaces next to the type in quadding out the lines of this exercise.

The examples showing how to space and justify long or short lines are set with special spaces which show just what spacing material is used. These examples, while *not intended as exercise copy*, should be called to the attention of the student when like problems arise.

That part of the lesson under the heading "How the spaces should be used" contains important information. The order in which the spaces may be combined should be memorized.

The spacing chart.—A copy of this chart should be placed on the frame and used by the student while he is setting exercises Nos. 6, 7, 8, 9, 14, 15, 16, and 17.

The chart will enable the student to set and properly space type lines with minimum effort. As he advances he should depend more and more upon his own judgment and in time will space rapidly and accurately without referring to the chart. The chart may be dispensed with as soon as it has served its purpose, as its continued use will not tend to make the student self-reliant. This chart must be used with regular spaces. It can not be used with point-set spaces. The chart tells what spacing will *approximately* fill the line. Final justification is left to the student.

SUGGESTIONS FOR TEACHING LESSON NO. III

In exercise No. 6 the paragraphs are indented. Text gives rule for paragraph indention. The second line does not fill the measure and the student faces the problem of properly quadding out the line. Instructor should see that all spaces are placed close to the type and the quads inserted last.

In the third paragraph the use of the hyphen in word division is taken up. The text of the exercise tells when and why it is used and how the word should be divided.

The last paragraph contains two sentences. The text gives directions for spacing. The old rule for spacing sentences within a paragraph with an em quad is not followed on high-grade hand composition; present-day standards call for closer spacing.

Call attention of the student to the text of the exercises before he starts composition.

Continue to insist on uniform spacing. Explain why less space is required after the commas appearing in the exercises.

SUGGESTIONS FOR TEACHING LESSON IV

Variations in the leading are included in this lesson. Demonstrate the proper method to follow when combinations become necessary. (See *Printing for School and Shop*, by Frank S. Henry, section 15.)

Show the pupil how solid composition should be handled.

SUGGESTIONS FOR TEACHING LESSON NO. V

Here the student will meet his first real problem in setting type. Rules for the division of words should be studied before the exercises in lesson No. 4 are started.

Individual instruction should be given as much as possible while the student is working on this lesson.

SUGGESTION FOR TEACHING LESSON NO. VI

This lesson may be omitted if the student be pressed for time in which to complete the course.

SUGGESTION FOR TEACHING LESSON NO. VII

This lesson is intended for the student who has completed the course in less than the required number of hours and has shown ability beyond the average.

8. REFERENCE BOOKS FOR INSTRUCTORS

1. *Printing for School and Shop*, by Frank S. Henry. Published by John Wiley & Sons, 432 Fourth Avenue, New York City. \$1.25. All references in the students' instruction sheets are taken from this book.

2. *The Art and Practice of Typography*, by Edmund G. Gress. Published by the Oswald Publishing Co., 231 West Thirty-ninth Street., New York. \$6.45.

3. *Correct Composition*, by Theodore L. DeVinne. Published by the Oswald Publishing Co., 231 West Thirty-ninth Street, New York. \$2.20.

4. *Plain Printing Types*, by Theodore L. DeVinne. Published by the Oswald Publishing Co., 231 West Thirty-ninth Street, New York. \$2.20.

5. Modern Book Composition, by Theodore L. DeVinne. Published by the Oswald Publishing Co., 231 West Thirty-ninth Street, New York. \$2.20.
6. Title-Pages, by Theodore L. DeVinne. Published by the Oswald Publishing Co., 231 West Thirty-ninth Street. New York. \$2.20.
7. Printing, by George Sherman. Published by Inland Printer Co., 632 Sherman Street, Chicago, Ill. \$1.
8. The Inland Printer, published monthly by the Inland Printer Co., 632 Sherman Street, Chicago, Ill. \$3 a year.
9. Printing Teachers' Co-operative Bureau, 444 West Fifty-seventh Street, New York City.
10. Making Type Work, by Benjamin Sherbon. Published by the Century Co., New York.

9. STUDENTS' INSTRUCTION SHEETS

The students' instruction sheets comprising Part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the students' instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets and using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

CONDITIONS IN THE PRINTING INDUSTRY

In considering any vocation as one's future life work there should be carefully reviewed the conditions which pertain in that particular occupation, not only for the purpose of ascertaining whether the work will be healthful, permanent and remunerative but also fitted to the individual who is planning to make it his sphere of activity. What does the printing industry offer with reference to these considerations?

From the health standpoint, there is no undue physical or nervous strain or unhealthy conditions peculiar to any of the printing trades. It may be understood, however, that for certain branches of the business there are certain physical qualifications essential at the outset due to the nature of the work involved. For instance, all branches of the trade necessitate more or less stooping over forms and contact with type; hence the youth with weak lungs or poor chest development should choose in preference some vocation which would tend to overcome this defect; printing would serve to make it more pronounced. The proof reader must have good sight if his eyes are to withstand the continuous strain imposed upon them in following this work; the pressman must have the necessary physical strength to handle heavy type forms, etc.

A more complete idea of these initial requirements may be gleaned by a careful study of the duties in each of the various departments of the printing trade, although it may be generally stated that in practically all of its branches the printing trade requires a class of workers above the average mentality, because, to a greater degree than in many other lines, it calls for the exercise of brain as well as of manual skill.

Regularity of employment is another item of paramount importance in the selection of a vocation. It is this which assures regularity of income which, in turn, together with the average rate of wages, forms a comparatively safe basis upon which the worker may fix his standard of living. Printing in this respect is attractive, inasmuch as it is so closely related to all lines of work and so essential to their promotion at all times that the number of wage earners remains comparatively steady throughout all seasons of the year. Following are comparative figures published in a Government report showing the number of wage earners in the printing and publishing business in the months of its greatest and least activity, respectively:

Average number.....	258, 434
Maximum number employed—December.....	269, 844
Minimum number employed—July.....	251, 757

(Which is 93.3 per cent of the maximum number employed at the height of the season.)

General instructions to students pursuing this course.—1. Stand upright at the case; do not lounge against the case stand.

2. Even spacing and uniform justification are absolutely essential. Read each line carefully and make needed corrections while justifying it.

3. Try a direct, sure, and steady motion; don't fumble.

4. Set your stick accurately and do not attempt to change same after you start setting type.

5. Read your copy over a little ahead of your composition to get the sense of it; the little time required for this will be nothing compared to the time needed to go back and make a change in the preceding line in case of misreading it.

Lesson No. I

Lay of the type case.—Read *Printing for School and Shop*, by Frank S. Henry, sections 1, 2, 3, 8, 14, 15, and all of Chapter II.

Exercise No. 1.—1. Set the composing stick at 20 picas.

2. With the stick held properly in the left hand, take a type from the largest compartment in the case (which contains the letter "e"), set in the stick with face toward you and nick in view.

3. Repeat this operation until the line fills the stick, thus:

eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee

4. Remove the line from the stick with a composing rule and hold in the left hand for distribution. Although the letters are all alike, they should be dropped into the case one by one in order to get the correct movement and control of fingers for distributing type. Several lines of the letter "e" should be set up and taken from the stick. The use of a single character makes "pi" impossible when the student is learning this operation.

Exercise No. 2.—1. Set the first of the following lines, inserting a 3-to-em space between words.

he he he he he he he he he he he he he he he he
the the the the the the the the the the the the
then them this there and then them this there and
aaaa but follow this copy and you will do excellent
work and quickly recognize the valueeeeeeeeeee
of juvenile application. eeeeeeeeeeeeeeeeeeeeeee

(Note to instructor: This exercise may be modified to suit the set of the body type used, but the 3-to-em space should be the only space used.)

2. When the line is set, read it in the stick to make sure that there are no mistakes.

3. Now, distribute the line, taking it from the stick and dropping the type in their proper places, as in the preceding exercise.

4. In the same manner, set, read, correct, and distribute each of the remaining lines.

NOTE.—Do not have more than one line in the stick at a time in this lesson. You have now used every lower-case letter. The lower-case characters are not arranged in alphabetical order, but rather for the convenience of the compositor. Some compartments, such as those containing the e, d, c, etc., are larger than others because the letters are the most used.

Exercise No. 3.—Filling in case diagram.—At this point the student should memorize the location of the remaining characters in the type case. The lower-case section also contains the punctuation marks, figures, ligatures (fi, ff, ffi, fl), and the spaces and quads. The capitals are arranged alphabetically, with the exception of J and U, which were the last letters added to the alphabet; consequently they are placed last. In the capital case are also placed the dollar sign, English pound mark, diphthong letters, &, ffi, and parenthesis marks. Study the following diagram of the California job case and test your knowledge of the location of the compartments by filling in a blank diagram.

Letters difficult to distinguish.—The beginner finds it difficult to distinguish between the lower-case b and q, d and p, n and u, and 6 and 9. The following method simplifies matters. As the printer reads the types when they are in a reversed position the b looks much like a p.

Exercise No. 4.—Set the following sentence from a pair of news cases:

The quick brown fox jumps over the lazy dog.

Fill in a diagram of the upper and lower news cases.

Questions.—1. Why are lower-case letters scattered about the case instead of being placed in alphabetical order?

2. Why are the capital letters J and U not placed in alphabetical order?

3. What is a ligature?

4. What is the name of the space you used in this lesson?

5. Name the different sizes of spaces that accompany the average font of type.

**This is the way the letters b, d,
p and q look on the type when in
the composing stick.**

NICKED END OF TYPE

p q b d

This is how
b looks

This is how
d looks

This is how
p looks

This is how
q looks

b d p q

**This is the way the letters look
when printed.**

**Fold inward on this line and
notice how the top part, represent-
ing the type, prints the letters on
the paper.**

Lesson II

Spacing material used in plain composition.—Read *Printing for School and Shop*, by Frank S. Henry, sections 8, 19, 20, 21, 22, and 23.

Exercise No. 5.—Set the following lines, space the words of each line according to the directions given in small type. Justify these lines in the stick, placing the necessary spacing material at the end of the line. Insert the spaces after the periods and place the quads last. While the line should be fairly tight in the stick, it should not be so tight that it is difficult to push down the spaces.

The stick containing the above lines should be inspected by the instructor before they are distributed.

How the spaces should be used.—The 3-to-em space is the right size to place between words in a line set in lower case. If more is required, the 3-to-em space is replaced with spacing pieces combined in the following order to obtain the necessary increase: Two 5-to-em, 5-to-em, and 4-to-em; en-quad, 3-to-em and 5-to-em; 3-to-em and 4-to-em, and two 3-to-em spaces.

When less space is required between words a 4-to-em space is used. Avoid spacing the entire line with 5-to-em spaces; words so thinly spaced are hard to read.

The hair space is needed before the colon, semicolon, interrogation point and exclamation point of some type faces. Sometimes a hair space is placed between the parenthesis and its adjoining character.

In this example we have a thinly spaced line.

Space with 5-to-em spaces.

The spaces used in this example have one nick.

Space with 4-to-em spaces.

We learn to tell one size space from another.

Space with 3-to-em spaces.

Hold the composing stick in the left hand.

Space with two 5-to-em spaces.

Read carefully few words of your copy

Space with 5-to-em and 4-to-em spaces

Set these in type and read more of copy.

Space with en quads

Locate a letter with your eye before setting.

Space with 3-to-em and 5-to-em spaces.

Try to develop a steady arm movement.

Space with 3-to-em and 4-to-em spaces.

Keep your mind entirely on the copy.

Space with two 3-to-em spaces.

Quotation marks should have hair spaces put between them and the quoted matter in every place where they abut or interfere with upright letters. The quads are used in straight matter composition for paragraph indentions and for filling out the last lines of paragraphs.

Now that the student has learned the "lay" of the type case and has become familiar with the spacing material, the composition of plain paragraphs will be taken up.

QUADS AND SPACES

**The spacing material
used in setting
body type**

Hair space	.	.	.	.	.	|
Five-to-em	.	.	.	.	.	|
Four-to-em	.	.	.	.	.	|
Three-to-em	.	.	.	.	.	|
En quad	.	.	.	.	.	■
Em quad	.	.	.	.	.	■
Two-em quad	.	.	.	.	.	■
Three-em quad	.	.	.	.	.	■

The spacing chart.—This chart is designed to help the beginner master the problems of spacing and justification.

The 3-to-em spaces are inserted between the words as the line is composed. Ascertain how many 4-to-em spaces the line falls short of filling the measure; count the words in the line and refer to the proper column in the chart to determine the combination of spacing pieces which will approximately space out the line. After replacing the 3-to-em spaces with these, make all changes necessary to properly justify the line, adjusting the spacing so that the spaces between the words will appear uniform.

A 3-to-em space is placed after each word as the line is assembled. The amount of space which the line is short may be measured by temporarily inserting 4-to-em spaces at the end of the line. Count the number of words in the line and refer to the spacing chart for the combinations of spacing pieces necessary to space the line out to fill the measure. According to the number of words in the line, the additional spaces or the replacement of the 3-to-em spaces with other spaces is indicated on the chart.

The space combination indicated on the chart will space out the line so that it will never be short more than one-quarter of an em. This allows the insertion of larger or smaller spaces to obtain a more even distribution of white space between the words.

Lines which can not be spaced with the chart.—If the line is less than an en quad short of filling the measure, replace the 3-to-em spaces with two 5-to-em spaces in as many places as may be necessary to properly justify the line.

Example

A LINE THAT IS LESS THAN AN EN-QUAD
SHORT OF FILLING THE MEASURE.

Be_careful_when_you_are_distributing_type_spaces.⋮

This line is two 5-to-em spaces short of filling the measure.

Be_careful_when_you_are_distributing_type_spaces.

The same line properly spaced.

The 3-to-em spaces being replaced with two 5-to-em spaces in 6 places

If the line is only one or two characters too long, replace the 3-to-em spaces with the 4-to-em spaces in as many places as may be necessary to get in the last word.

Example

A LINE THAT IS TOO LONG

A_good_printer_always_keeps_his_type_case_in_order

This line is 2 characters too long

A_good_printer_always_keeps_his_type_case_in_order.

The same line properly spaced

The 3-to-em spaces being replaced with the 4-to-em in 7 places.

When the spacing chart is used.—When using the table on the first line of a paragraph, the indentation is thought of as a part of the first word.

Example

The_space_between_words_should_appear_even.⋮⋮⋮

This line contains 7 words and is short six 4-to-em spaces (1.1-2 ems)

The_space_between_words_should_appear_even.

Line spaced out to fill the measure according to the chart:

3 and 4-to-em spaces in all places.

Questions.—1. Name all of the spaces and space combinations in their proper order.

2. What are the hair spaces used for?

3. When spaces and quads are used with words, why should the spaces be placed close to the words?

4. In spacing out a line of type, after what letters should the space be decreased? After what letters should the space be increased?

5. Would you place less space or more space after a comma.

Lesson III

*Plain paragraph composition (use spacing chart explained in Lesson II).—*Indention, division of words, spacing of sentences within paragraphs, quadding out.

Read *Printing for School and Shop*, by Frank S. Henry, sections Nos. 24, 25, 26, 27, 32, 35, 36, 37, 39, 41, and 42.

Exercise No. 6.—Read each paragraph carefully before starting to set it in type.

An em quad is placed at the beginning of every paragraph where the type is set in this measure.

I form the words of the copy and place a space after each word to separate it from the next.

If the line is very short, to avoid excessive spacing between words, a word is divided on a syllable at the end of the line and the remainder of the word placed in the next line.

An en quad should be placed before a sentence within a paragraph. If the line is widely spaced, the space may be increased, but not to exceed an em quad.

Exercise No. 7.—

At the end of a paragraph, when quads are used to fill out the line, the spaces necessary to justify the line should be placed next to the words. Do not put less than an em quad on the end of a line of quads and spaces with words.

A paragraph should not end closer than an em quad from the end of the line. Avoid ending a paragraph with a syllable of a word on the last line.

Exercise No. 8.—

In making corrections always justify the line in the composing stick, respacing the line, if necessary, to make the spacing uniform after correction has been made.

Correction should be made carefully, particular attention being given to any change in justification, and especial care taken that no type is injured during the process.

In no case should a correction be made on the galley, unless the letter or figure to be inserted is the same size as the one taken out.

These exercises should be placed on the galley, tied up, proved, corrected, and revised.

Questions.—1. What is meant by paragraph indention?

2. When would you divide a word at the end of a line?

3. What spacing material would you place before a new sentence in a paragraph?

4. Make a diagram showing the proper way to place a job on the galley.

5. Why should the type lines be returned to the stick when corrections are made?

6. Name two uses for the hyphen.

7. Write 10 words containing a ligature.

8. Draw a capital O, a lower-case o, and a cipher 0.

Lesson IV

The hanging indention and the half-diamond indention.

The composition of poems.

Leaded, double-leaded, and solidified composition.

Exercise No. 9.—Set the following copy in hanging indention:

Hanging indention

This indention is made by setting the first line the full width of the required measure and indenting at the beginning of each following line, one em, or more if the measure be wide. It is a form of indention useful in many classes of job work.

Exercise No. 10.—Set the following copy in half-diamond indention:

Half-diamond indentation

This indentation is useful in title-pages and many kinds of job work. It is formed by gradually narrowing the lines. Care must be taken to indent evenly, and the matter should end as nearly in a point as it is possible to set it.

Composition of poetry

Read *Printing for School and Shop*, page 72.

Also section 14, page 10.

Section 15.

Exercise No. 11.—Set the longest line of the poem in your stick, then adjust the stick to a measure which will just cover this line. Open the lines of this exercise with *one lead*. Follow copy in the indentation of the lines. Space with 3-to-em space.

When Freedom, from her mountain height,
Unfurled her standard to the air,
She tore the azure robe of night,
And set the stars of glory there!
She mingled with its gorgeous dyes
The milky baldric of the skies,
And striped its pure celestial white
With streakings of the morning light:
Then, from his mansion in the sun,
She called her eagle bearer down,
And gave into his mighty hand
The symbol of her chosen land!

Exercise No. 12.—Repeat the operation of determining the measure. Note that riming lines have the same indentation. Insert *two leads* between the type lines. Matter opened in this manner is said to be "double-leaded."

Majestic monarch of the cloud!
Who rear'st aloft thy regal form,
To hear the tempest-tramping loud,
And see the lightning-lances driven,
When stride the warriors of the storm,
And rolls the thunder-drum of heaven!
Child of the sun! to thee 'tis given.
To guard the banner of the free,
To hover in the sulphur smoke,
To ward away the battle stroke,
And bid its blendings shine afar,
Like rainbows on the cloud of war,
The harbingers of victory!

Exercise No. 3.—Do not insert leads between the type lines. Composition set in this manner is called *solid* composition:

Flag of the seas! on ocean's wave
Thy star shall glitter o'er the brave;
When Death, careering on the gale,
Sweeps darkly round the bellied sail,
And frightened waves rush wildly back
Before the broadside's reeling rack,
The dying wanderer of the sea
Shall look, at once, to Heaven and thee,
And smile, to see thy splendors fly,
In triumph, o'er closing eye.

- Questions.*—1. What is a hanging indentation?
2. What is a half diamond indentation?
3. In starting to set a poem, how do you determine the measure to set the stick?
4. What rule is usually followed in indenting poetry?
5. What is meant by double-leaded matter, leaded matter, solid matter?

Lesson V

Setting reprint copy in different measures.

Setting typewritten copy marked by the author.

Setting manuscript copy.

Read Printing for School and Shop, by Frank S. Henry, sections Nos. 66 and 69.

Exercise No. 14.—Set the following reprint copy, changing the measure to 18 picas:

Quotation marks are made by using two inverted commas at the beginning of a quotation and two apostrophes at the end. In case of a quotation within a quotation single marks only must be used.

Should the double and single quotation marks come together, separate with a thin space.

"This line is quoted."

The fascination of the printing art for all those who have at one time or another come into contact with type, ink and paper, has been written about many times. We do love our craft, and when we stop to analyze this attraction, we find that it is well justified by the material and cultural returns we receive.

Does the artistic appeal to you? Then printing will permit you to express your art instincts almost without limit, and nearly all the general principles of design and color are employed in printing. Have you a literary bent—fond of the English language? Printing will be a pleasure to you from this viewpoint. The mechanical phase of printing appeals to one mechanically inclined, as thoughtful and careful workmanship is essential to satisfactory results.

The material benefits derived from printing are not to be underestimated. Even the man who remains only a craftsman, and never rises to be an executive or proprietor, is reasonably certain of steady employment at decent wages. For the successful proprietor the growth and prestige of his business is limited only by the ability of the man.

Exercise No. 15.—Take the same copy used in the preceding exercise and set it to a measure of 22 picas.

Directions for setting Exercise No. 16.—Set this typewritten copy to a measure of 20 picas. Note all the directions marked on the copy.

A slanting mark down through a capital letter signifies that the letter should go in lower-case.

Three lines drawn beneath a word signify that it is to be set IN CAPITALS; two lines, that it is to be set in SMALL CAPITALS; one straight line, in *italic*; one wavy line, in **bold face**.

A caret (^) is placed in the copy where additional matter written in the margin is to be inserted.

The paragraph mark indicates that a new paragraph is wanted.

A circle drawn around an abbreviated word indicates that the word is to be spelled out in full.

Exercise No. 17.—Set this manuscript copy in type to a measure of 20 picas.

Question.—See *Printing for School and Shop*, by Frank S. Henry. Glossary, page 281.

1. Explain the meaning of the following terms: Cabinet, caps, composing rule and composing stick, copy, dead matter, distribution, en, galley, leaded matter, ligature, live matter, lower-case, measure, nick, overrunning, pi, planer, quads, revise, small caps, solid matter, take, turned letter, wrong font.

Lesson VI

Characters which comprise a complete font of type.—Read *Printing for School and Shop*, pages 73 to 82.

Exercise No. 18.—Set to a measure of 20 picas.

A font of type is a complete collection, with a proper apportionment to each character, of the metal types required for an ordinary text.

A so-called complete font of roman and italic type is supposed to contain ROMAN CAPITALS, roman lower case, ROMAN SMALL CAPITALS, *ITALIC CAPITALS*, *italic lower-case*, punctuation points, reference marks, money signs, figures, commercial signs, and spaces and quadrats.

SMALL CAPITALS

Small capitals are of the same design as the capital letters, but are no taller than the round letters of the lower-case. They are about one-half as large as the capitals. The small capitals were introduced by Aldus Manutius, at Venice, in 1501.

Italic

Aldus Manutius was the first printer to use italic types. He introduced the italic letters and capitals together. The italic types were made in imitation of the close and careful handwriting of the Italian poet, Petrarch.

Exercise No. 19.—Set to a measure of 20 picas:

CAPITAL LETTERS

The roman capitals, with the exception of J, U, and W, are the letters which were used for inscriptions on stone by the Romans, and have come down to us without change. The J, U, and W were added later when their introduction was found expedient. Roman capitals have a single height and many features in common, among which may be mentioned the slightly decorative finals with which the lines are finished. This part of a letter is called the *serif*.

The diphthongs Æ and Œ are not needed for words purely English, but their occurrence in Latin compels the type founders to provide them for the five series of a complete font.

The CAPITAL LETTERS are often called *upper-case* characters because of the higher position of the cap case on the inclined composing frame.

Lower-case letters

The small text types are often referred to as *lower-case*, because the case containing these characters is placed below the cap case on the composing frame. The lower-case letters are an evolution from the upper-case or capital letters. Use of the pen and brush in lettering and the tendency to letter rapidly finally gave us the lower-case characters. The early printers copied these letters from Latin manuscripts.

Exercise No. 20.—Set to a measure of 20 picas:

Punctuation points

The following marks of punctuation are usually included in every complete font of type: x . - , ; ' ! ? () —. In the infancy of the art of printing, the virgule, a slanting

mark, supplied the place of the comma. Colons and periods are found in the works of all the early printers. By slow degrees point after point was added by various printers, the chief signs being taken from Greek and Latin manuscripts. Aldus Manutius was the first printer to introduce a regular system of punctuation.

Exercise No. 21.—Set to a measure of 20 picas:

Arabic numerals

The Arabic numerals, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, like other characters used by the printer, have passed through an evolutionary process. These signs were first introduced into Europe in the twelfth century by the Arabians. They were not, however, invented by that people, but were derived by them from Hindustan. The characters were originally the initial letters of the Sanskrit names for the nine digits, one, two, three, etc., but have undergone considerable changes of form. The cipher was originally a dot, used as a mere arbitrary sign to mark a place or local value.

Exercise No. 22.—Set to a measure of 20 picas:

Reference marks: * † ‡ || § ¶

These characters are used to refer the reader from the text to marginal or footnotes, the latter being always preceded by a mark similar to that used in the portion of the text to which it relates. Common references are generally used in the above order.

While reference marks are still used by some publishers, the superior figures made by the type founders for this purpose are more slightly and are most frequently used.

Ligatures

A type representing two or more letters or characters united is called a ligature. The type founders make the ligatures fi, fl, ff, ffi, and ffl on account of the kern or overhanging top of the letter f.

Money signs

These characters come with all fonts of both roman and italic. The origin of the sign \$ has been variously accounted for, but it is probably a modified 8, denoting a "piece of eight," i. e., eight reals—an old Spanish coin of the value of a dollar. It was in use long before the adoption of the Federal currency.

The character £, for Pounds Sterling, is merely a capital L with a mark drawn across it, and represents the corresponding Latin for *Librae*.

The ampersand, &

This sign is a combination of the letters e, t, of the Latin *et*, meaning and. Printers usually call this sign a "short and." In old-fashioned primers and nursery books the sign was added at the end of the alphabet.

Questions.—1. How can you distinguish old style from modern?

2. What is a serif?

3. What influence has a serif on the appearance of a type face?

4. What is the supposed origin of the serif?

5. Why do type founders include Æ and Œ in a font of type?

6. Why are the lower-case letters so called?

7. What are reference marks used for?

8. What is a kern?

Lesson 7

The American point system.—Read *Printing for School and Shop*, sections Nos. 4, 5, 6, 7, 8, 9, 11, 12, 13, 17, 103.

The point system is the result of the efforts of all the type founders of America to create a universal measurement for type bodies, both metal and wood. Particular stress is laid upon the word "bodies," in order that the student will note that the size of type does not depend upon its face, but upon the measurement of the body of the type.

The unit of measurement is the point, which, for all practical purposes, is one seventy-second of an inch; thus, 72 points are equal to 1 inch. An 18-point type is one-fourth of an inch, though the letter on its face may be only one-eighth of an inch in height.

Although the unit measurement, as stated above, is the point, it has been found necessary, for convenience sake, to adopt a unit that is larger, hence for most practical purposes the "pica" or 12-point em is used to designate the width and length of type forms and accessories. Instead of saying a page of type was 240 points wide by 540 points long, we should state that it was 20 ems wide and 45 ems long. The advantage of the measurement in ems is obvious. When desired to use inches instead of ems we allow 6 ems to the inch. For instance, a job 18 by 16 ems would be 3 by 6 inches.

Metal types range in size from 4-point body to 120-point body. Above these sizes the types are usually made of wood on account of the saving in material and weight. Wood type is sometimes made as small as 48 point, or, as it is more generally called, 4-line, allowing a pica or 12 points to the line.

All type, ornaments, brass rule, borders, initials, etc., are now made on the point system, in order that they may be composed into the job in the shortest possible time and with the greatest possible convenience.

Attention is called to the fact that the "em" in type measurement has two separate and distinct meanings, viz:

1. An "em" is the square of its own body. An em of 24-point would be 24 points in each direction.

In this sense it is used for the purpose of measuring the number of square ems contained in a quantity of type matter, thus enabling an estimator to ascertain the costs of composition.

2. The other use of the "em" has already been referred to as a unit of measurement to designate the dimensions of a type form, reglet, furniture, and wood type. It is the square of the 12-point or pica type.

The width and length of any job can always be expressed in picas (standard ems). The standard em is 12 points. When we say "10 ems" we mean "10 picas."

Previous to the adoption of the point system different sizes of type were known by names. Memorize:

6 points equal one nonpareil.

12 points equal one pica.

72 points equal one inch.

6 picas equal one inch.

72 picas equal one foot.

Exercise No. 24.—Set each of these lines in the size type named in the copy:

This line is set in 6-point Century expanded.

This line is set in 8-point Century expanded.

This line is set in 10-point Century expanded.

This line is set in 12-point Century expanded.

Standard lining system of type faces.—Six-point type will line with 8-point type if a 1-point lead be placed at the top and bottom of the 6-point type.

Eight-point type will line with 10-point type if a 2-point lead be placed at the bottom of the 8-point.

Ten-point type will line with 12-point type if a 1-point lead be placed at the top and bottom of the 10-point type.

Exercise No. 25.—Set your name in 12-point and 10-point capitals, using 12-point capitals for the initials.

Set your name in 10-point and 8-point capitals, using 10-point capitals for the initials.

Set your name in 8-point and 6-point capitals, using 8-point capitals for the initials.

Exercise No. 26.—Set this paragraph and underscore the two words in the last line as in copy.

Use of brass rule in underscoring words

A good way to get almost perfect underscoring is to use on either side of words to be underscored spaces two points larger than the type, and then justify underscoring rule flush to spaces, with leads on either side as shown. Then the rule can not possibly slip, and if justified flush to the spaces is just as long as the word or words underscored.

Leads often too short, or rules too long.

Exercise No. 27.—Set these paragraphs in 10-point type. Start the first word of the first paragraph with a 24-point capital and set the remaining letters of the word in 10-point capitals.

Initial letters.—The use of initial letters may be classed as a form of emphasis. When we see an initial in the middle of a booklet page the eye marks it as a fresh start; the beginning of a new thought. And it helps to break the monotony of a plain type page.

Many of the old manuscript books were decorated with bright colored initials. All of the early printed books were copies, more or less faithful, of the manuscript model. Large blanks were left for initial letters that should grace the beginning of every chapter or other important division. After the printing of the text type had been carefully completed, initials and borders were added by a professional illuminator.

The first book with a printed date (Fust and Schoeffer's Psalter of 1457) contains initials printed from wood blocks.

The first decorative initials printed from type metal were designed in 1477 by Erhard Ratdolt at Venice.

Measuring type areas.—When determining the amount of type contained in a piece of printed matter the *em* is taken as a unit of measure. An *em* of any type is the *square* body of that type. As it is impracticable to count all the bits of metal in a page, the *em* is made a unit of superficial measure. The space that can be covered by 1,000 *em* quadrates is reckoned as 1,000 *ems*. The *em*, therefore, is a square whose sides are a number of points. A 12-point *em* is 12 points each way. The number of *ems* in any composition corresponds to the number of these squares contained therein. A square 6 points on each side is called a 6-point *em*, etc.

To find the number of *ems* of type in any job or page, multiply the length of line in picas by 12 and divide by whatever size of type is used. This gives the number of *ems* in each line, and to find the grand total is merely a matter of multiplying by the total number of lines.

Exercise No. 28.—Select four proofs of work that you have done in this school and find the number of *ems* of type in each.

Questions.—1. What part of an inch is a point?

2. In setting a line containing 10 point and 12 point, where would you place the necessary justifying material to make the faces line?

3. How would you proceed to find the number of *ems* in a page of composed type?

4. In what unit of measurement is the width and length of a job expressed?

5. A page contains 8 lines of 10-point type, 1 line of 12-point type, and 14 two-point leads. How many picas and points in the length of the job?

Rehabilitation monograph. Joint Series No. 65.

Unit Course—Printing 4—Elementary Book Composition

PRINTING

February, 1919.—Trial edition

PART 1. INSTRUCTOR'S MANUAL

1. QUALIFICATIONS OF STUDENTS

This unit course is intended for men who have completed the unit in Elementary Composition (Series No. 64) in a satisfactory manner, or who have had some previous experience in printing and are qualified to do the work of this unit.

2. ATTAINMENTS OR ADVANTAGES

Upon completing this course the student should have a practical insight into the best practice in the printing trade, and ability to perform accordingly the following:

1. To exercise good judgment in the use of spaces and indentions.
2. To know the difference in form and the proper use of the various styles of type faces in common use.
3. To compose and arrange footnotes, marginal notes, and cut-in notes on a book page, with reference marks.
4. To calculate the amount of type required for a given piece of manuscript.
5. To use proper style and arrangement of initial letters.
6. To interpret properly an author's manuscript.

3. LENGTH OF COURSE

A student of average ability should successfully meet the requirements of this unit in 30 hours. He should, however, continue in this unit until he is able to do the work; he should be at once promoted to the next unit, regardless of the time that he has spent on this course.

4. EQUIPMENT AND MATERIALS

The list of equipment and materials recommended for the unit on Elementary Composition (Series No. 64) will be sufficient for the work outlined in this course.

5. MEASURING, RATING, AND RECORDING STUDENT'S WORK

See discussion under this heading in Unit Course Printing 1, Elementary Composition, Series No. 64. Upon the completion of this unit in book composition the student should have a knowledge of what good book composition is, and should be able to set and correct 250 ems of 10-point type per hour.

6. PRESENTATION OF THE PROBLEMS

A series of elementary lessons for the use of beginners in book composition follow this article. These lessons are so planned that the fundamental operations of book composition may be taught in a thorough and efficient manner.

Spacing.—This is a very important factor in the making of a pleasing page. A safe rule to have the student follow is to have the space between the words correspond as nearly as possible to the space between the lines; that is, in a page leaded with 2-point leads the average space between words should be an em quad; but, no matter how widely the lines may be separated, the word space should never exceed an em quad. On the other hand, a solid page should have an average spacing of 3-to-em spaces.

The instructor should see that the student uses care in justifying each line properly. The best time to exercise this care is while the type is in the composing stick; before passing on to the next line he should look it over carefully for typographical errors.

Indentation.—The student should not be allowed to indent text matter of 3 ems or more in a narrow measure, as it is almost as wasteful of space as a full white line. The object of indentation, the leading of the eye to a noticeable white space that indicates a break in the discourse or writing, is defeated when that blank is made too wide, compelling the turning over of too many short lines. The proper adjustment of indentation and of breaks at the end of paragraphs is as important as even spacing.

Another important rule to have the student follow is, when two or more sizes of type are used on the same page the paragraph indentation for each size should be of uniform width. Footnotes may be excepted when they are in half measure. When a footnote in broad measure is a citation of authority not exceeding two lines the first line may be full or nearly full, but the following line should be centered.

Type faces.—Before proceeding to a study of type faces the student should be taught something of the general characteristics of the old-style and modern faces.

In an extremely interesting article, printed in the *Graphic Arts* for March, 1911, Henry Lewis Bullen showed how he had set a line of gothic type and had it photographed. He had 10 prints made from this model. To each of these models a different serif was added, thereby producing 10 entirely different faces of type.

The instructor should have the students make a comparison of the serifs of the old-style and modern type faces.

Notes used in bookwork.—When the student has learned the proper methods of spacing and indenting type matter and is able to distinguish the difference between an old-style and modern type face he should be given instruction in how to set the different kinds of notes used in bookwork.

The signs that were used for many years to refer to notes, such as the star, dagger, double dagger, parallel, etc., are still made a part of some fonts of type, but should no longer be used, as they are now rated as disfigurements to the page. Superior letters and figures are preferred; they are neater and permit of any number being used without repetition or confusion.

Type calculations.—Upon the conclusion of this course the student should be able to determine how much matter a certain piece of copy will make when it is set in type. He should also be instructed how to determine the size of type to use to fill a certain space with a certain piece of copy.

Initial letters.—Do not allow the student to use too black an initial for a light roman type. It distracts the reader's attention from the interest of the text matter.

If the initial letter used is taken from a regular font of, say, 48-point type, the shoulder will have to be cut off, making the initial on a body of 40-point. This permits of uniform space around the initial.

About copy.—Copy should be carefully prepared for the apprentice. When copy has been negligently prepared it is the duty of the instructor to correct these faults before giving it to the student to set. This work never can be done easier or better than just at this time. Many of the so-called errors of the press begin with bad arrangement of copy and indistinct writing.

7. REFERENCE BOOKS FOR TEACHERS

See list of reference books given in unit course in elementary composition.

8. STUDENT'S INSTRUCTION SHEETS

The student's instruction sheets comprising Part 2 of this course are planned to be given out to the students one lesson at a time, withholding the new lesson until the one in hand is satisfactorily completed. For convenience in printing, the student's instruction sheets have not been printed separately, as was originally intended, but have been included in one pamphlet. Enough copies will be furnished to permit cutting out the sheets, using them separately. With some students there may be no objection to using the complete bulletin at one time.

PART 2. STUDENTS' INSTRUCTION SHEETS

Lesson 1.—Spacing

1. Study:

De Vinne's *Correct Composition*, pages 198 to 208.

2. Practice:

- (1) Read carefully the following selection on spacing.
- (2) Set your composing stick at 20 picas and set up this selection in 10 point, being careful to follow out in your composition the principles stated in the selection.
- (3) Make a galley proof of your composition, then read and correct it.
- (4) Submit your corrected proof to your instructor for his criticism.
- (5) When a perfect proof is secured, clean and distribute the type.

Spacing

Composition is made more pleasing when the spaces between words seem to be of the same width in all lines on the page.

Even spacing is not easily secured. Whether the measure is narrow or wide, whether the type is fat or lean, the compositor has to put in type the words as set down in this copy. He must divide words on syllables only, but some syllables and some words have many letters and may not be divided at all. He can not compress the types, nor abbreviate a long word, as was the prevailing practice in the early days of typesetting. To avoid this fault he may have to over-run and respace preceding lines so that he can take in or drive out the word that threatens uneven spacing or wrong division.

3. Questions:

1. Is even spacing easily secured?
2. Can em quads be used between words?
3. What is a thick space?
4. Which is the thicker, a 3-to-em space or a 4-to-em space?
5. Can you abbreviate a long word?
6. How should words be divided?
7. To make even spacing seem even, should the spaces between words be of the same width?
8. What size spaces should be used for solid composition?

Lesson 2.—Indention

1. Study:

De Vinne's *Correct Composition*, pages 182 to 197.

2. Practice:

- (1) After reading carefully the following paragraphs on "Indention," set up the same in 10-point type, 20 picas wide, solid. Use an em quad for the indention of each paragraph. Make a proof with this arrangement.
- (2) Single lead the matter and make a proof.
- (3) Double lead the matter and make a proof.
- (4) Triple lead the matter and make a proof.
- (5) Now rejustify the matter, using 2-em quads for the indentions, and make proofs in solid, single lead, double lead, and triple lead.
- (6) Again rejustifying (or resetting, if necessary), use 3-em quads for the indentions and make proofs in single lead, double lead and triple lead.
- (7) Compare your proof and decide which leading gives the most pleasing appearance for each indention used.

Indention

The 1-em indention for the regular paragraph is most frequent, but indention changes with varied forms of composition. For solid matter, 1 em at the beginning of a paragraph is enough to give the intended distinction of a change of subject. When the matter is wide leaded or white lined and the white space between lines is therefore made larger, 2 or 3 em quadrats are often used.

These wide indentions are striking, but they have disadvantages. If the preceding paragraph ends with a single syllable, it is practically separated from its following paragraph by a full white line of irregular shape, which makes an awkward gap.

3. Questions:

1. Why are lines indented?
2. What is a paragraph indention?
3. When are paragraph indentions not needed?
4. What is a hanging indention?
5. What is a half-diamond indention?
6. When are hanging indentions used?
7. What is the difference between a half-diamond indention and a hanging indention?
8. What is a squared indention?
9. What is an irregular indention?
10. What is a diagonal indention?

Lesson 3.—Type faces

1. Study:

Henry's *Printing for School and Shop*, pages 73 to 83.

It is very essential that the student learn something of the general characteristic of type faces. The first impression that one receives when set adrift in a large printing office is that he will never be able to learn the different type faces. The task is really not such a difficult one after all.

1. Study—Continued.

Roman type faces are subdivided into old style and modern. The chief difference in modern and old style lies in the matter of proportion, both being substantially the same in form. In old style there is greater variety in the widths of individual letters, the thickening of the curves in the round letters not being in the center of the curves as in the modern, but above and below the center according as it occurs on the left or right.

Study also the specimen books of the various type founders.

2. Practice:

Set the following sentence in 12-point, 30 picas wide, in each type face that can be found in your equipment:

“The student should learn something of the general characteristics of type faces.”

Compare the proofs to note the differences in the various type faces with reference to the following points: Proportion, width of line, shading, serif, general appearance and effectiveness.

3. Questions:

1. How can you distinguish old style from modern?
2. Why was italic type so called?
3. When and by whom was modern roman first cut?
4. Is your favorite newspaper printed in old style or modern?
5. What is a serif?
6. What influence has a serif on the appearance of a type face?
7. What do you understand by a type “family”?

Lesson 4.—Notes used in bookwork

1. Study:

De Vinne's Correct Composition, pages 171 to 181.

2. Practice:

Set the following about 20 picas wide. Use your own judgment as to type sizes according to principles stated in the selection.

Study the proof carefully to see if any improvements could be made in your composition.

Notes are a hindrance in composition and making up when they have to be affixed to a page that has engravings, or when they

NOTES USED are many in number, or are of unusual length.¹
 IN BOOKWORK. Footnotes are generally three sizes smaller type than text, with thinner lead, and solid with solid text.

For cut-in marginal notes type should generally be one size smaller than footnotes, unless more prominence is desired, in which case some small condensed antique or boldface may be used.

3. Questions:

1. If a textbook is set in 12-point, what size type should the footnotes be set in?
2. What is a footnote?
3. What is a side note?
4. What width measure is generally used for side notes if a book page measures 5 by 7½ inches?
5. What is a cut-in note?
6. How should a cut-in note be set?
7. What is a shoulder note?
8. What is a center note?
9. How much space should be allowed between text of book and a footnote?
10. What reference marks are used to refer to notes?

¹A long note may have its reference mark on the last line of the page, and the following page or pages may have other notes that can not be shown complete in the proper place, but must be split and put on other advanced pages.

Lesson 5.—Type calculations

1. Study:

Henry, *Printing for School and Shop*, pages 36 to 42.

2. Practice:

From the explanation given in the following selection, compute how many lines it will make when set in your 10-point body type 24 picas wide.

Set up the selection and see how near your calculation is correct.

3. Questions:

- (1) If copy contains 10,000 words, and we get 8 words in a line of type, how many lines will it make?
- (2) Copy consists of 10 pages of manuscript, averaging 30 lines to a page and 8 words to a line, how many lines of type will it make if we can get 10 words in a line?

Type Calculations

It is frequently necessary to determine how much matter a certain piece of copy will make when it is set in type. This may readily be calculated. The first step is to approximate the number of words in the copy. This is accomplished by multiplying the number of lines in the copy by the average number of words in a line. In averaging the number of words in a line assume that a word of seven letters is a normal word; call two small words one and a very large word two. If it be manuscript copy we may have to go over it all, unless it runs fairly uniform. With typewritten copy, which is more uniform, and easier to calculate, find the average number of words per line, multiply by the number of lines to get the number of words per page, then multiply this by the number of pages to get the total number of words in a copy.

Having determined the number of words in copy, set a line of the type to be used, and find the average number of words to a line. Dividing the number of words in copy by the number in one type line will give the number of lines the matter will make in type.

- (3) If we wish to prepare copy so that it will fill a certain space, and we determine that the size type we wish to use runs 9 words to a line, how many words should we write to fill 90 lines?
- (4) How many picas in $\frac{3}{4}$ inch?
- (5) What decimal of an inch is 6 picas?

Lesson 6

1. Study:

De Vinne, *Correct Composition*, pages 146, 147, and 148.

Henry, *Printing for School and Shop*, pages 99, 100, 101.

2. Practice:

Set the following selection, using an initial of suitable size and style at the beginning of each paragraph.

2. Practice—Continued.

Avoid a lavish use of initials as well as of other ornamentations. If the page is to be printed in one color, do not select a big, heavy initial to go with a light-face text; violent contrasts are not desirable in bookwork. The number of text lines that are covered by an initial must be considered in relation to the size both of the page and of the type. In small pages with type of 10-point size or smaller, a three-line letter will often be large enough.

The top of an initial should be even with the top of the first line of the text; when it is intended to be set in a corner, it should be fitted in neatly and lined exactly on the outside and the top.

When a plain roman letter is selected for a large initial it will look neater if it is of a style similar to the text letter; that is, if the text is old-style letter an initial of modern cut is not a suitable mate. If the text matter is in italic, an italic initial will be better than one of the upright style.

The word of which the initial is a part should be set in capitals. If it is a word of less than three letters the next word should also be in capitals. If the word is a part of a name or title the whole name or title should be in caps.

3. Questions:

1. If the text and initial are in one color, should they harmonize?
2. If the initial is to be printed in a different color than the text, can it be of a heavier-face type?
3. Is it customary to have the same amount of white space along the side of an initial as at the bottom?
4. Should letters like capital A and the capital L be mortised? Why?
5. If a paragraph begins with a two-letter word, is it customary to capitalize the second word?
6. Should the initial line up with the top of the balance of the word?
7. When a chapter with an initial begins with the proper name of a person, should each part of the two or more words be put in capitals?

Lesson 7—About copy

When copy has been negligently prepared by a careless writer who sometimes spells incorrectly and capitalizes and italicizes without system it is the duty of the compositor to correct these faults according to the style prescribed by the office in which he works; but when copy has been carefully prepared by a writer who plainly shows that he has a style of his own, that copy should be followed faithfully, even if it does conflict with the system of the office. It is the author's right to go before the public in his own way; to show his own notions about italic, punctuation, and capitalizing, and to follow the spelling of Webster, Stormonth, or Doctor Johnson.

Copy should be written with ink, and on one side of the leaf. That which has been written on both sides often has to be cut apart in two or three slips and given to different compositors. The reuniting of these slips gives needless trouble, and it may be done badly and lead to very serious error. Pencil writing makes bad copy unless it has been done with an indelible pencil.

Additions to a manuscript should never be written on the back of a leaf, where an addition is liable to be overlooked; if an addition is made, attention should be directed to it by markings on the face of the copy. It is better to write out the addition on a separate slip of paper and to paste it on in its proper place, where it will not be overlooked.

1. Study:

De Vinne's *Correct Composition*, pages 327 to 344.

2. Questions:

1. When copy has been negligently prepared by a careless writer who sometimes spells incorrectly, should the corrections be made by the compositor?
2. Should additions to manuscript be written on back of leaf?
3. Should copy be written on both sides of the paper?
4. What is the size of commercial note paper?
5. What is the size of letter paper?
6. Should manuscript be kept flat? Why?
7. Should copy be written in ink or pencil?

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